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NATURAL HISTORY

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1942

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THE MUSEUM AND HUMAN BETTERMENT

WE OF the Museum believe that Man's ignorance, selfishness, and brutality must be combatted by teaching old and new truths of Nature and that Nature will provide both the knowledge and faith upon which Man can build for the future. These truths are revealed in the halls, laboratories and teachings of our Museum.

We proclaim a world where people live in harmony with Nature, and this presupposes Man's greater knowledge of Nature and his relationship to the world and his fellow man. Appreciating Nature, Man will conserve and utilize—not waste and destroy its resources—, so that these resources will be available for human betterment.

It is also essential for Man to control forces within himself. This requires more fundamental knowledge of Man's origins, physical make-up, and above all, his instincts and emotions. Man is said to be the slave of his emotions. But the pages of history show that selfish leaders use their knowledge of human psychology to enslave Man. The Museum proclaims that Man, through greater enlightenment and better understanding, will free himself from such slavery and build a social framework strong enough to bear the weight of the future.

The source material upon which these fundamental truths are based are all present in our vast collections and researches thereon. Furthermore, we have the opportunity of bringing out these truths in interesting and striking exhibits and teaching for the enlightenment of the millions of people who pass through our halls, read our publications, listen to our broadcasts.

A. Perry Osborn

First Vice President of the Board of Trustees,
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NATION
IN
PEACE
AND
WAR

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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — WAYNE MOODY FAUNCE, Acting Director

VOLUME XLIX—No. 1 ★ ★ ★ ★ ★ ★ **JANUARY, 1942**

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Detail of an American Museum exhibit mounted by Robert H. Rockwell
From a Kodachrome by Thane Bierwert and Robert E. Logan

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ASSOCIATE: D. R. Barton.

ASSISTANT: Ruth Gannett.

ART AND PRODUCTION: Frederick L. Hahn.

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The Devil's

One of the most dramatic chapters in our frontier history is the epic story of a road on which more than 400 persons have perished from heat and thirst, the last of them within the past few months

You would not think that there was a road in the United States on which more than 400 persons perished in only a few years and that as recently as last August seven persons died of thirst in the region.

At Wellton, Arizona, our starting point, they told us of another recent death. "We found his body three miles from his car," they said. "He'd taken the last of his radiator water in a canteen and wandered north. He was under an elephant tree—dead for about a month." This was a prospector, looking for the legendary riches of El Camino del Diablo—the Devil's Highroad, whose record is unparalleled in the whole of North America.

From the Gila River, in Arizona, to the little Mexican hamlet of Sonoyta, sleeping fitfully in the desert silence just below the border, there are still visible to the rare traveler the tracks of wagons along this old trail. From time to time a little pile of rocks, sometimes surmounted by a rude cross, sometimes by a broken wagon wheel, marks the final resting place of some thirst-crazed passer-by. Sometimes one comes across the skeletons of horses, burros, or cattle, and sometimes there is a glimpse of a bleached human skull beneath the twisted cactus.

The Devil's Highway is a short cut, a chord to the vast arc of the Santa Cruz and Gila Rivers, permitting a saving of 200 miles from the old Spanish settlements in Sonora to the Colorado River. Long before the coming of the white man, primitive Indians shuffled along the trail, using it as a trade route between the Papago country and the Gulf of Baja California.

The first white man known to have traveled this Devil's Trail was Padre Eusebio Francisco Kino, Great Apostle to the Pima Indians, famous pioneer missionary in northern Mexico and southern Arizona. Father Kino, accompanied by Captain Juan Mateo Mange, made the journey in February, 1699. Leaving Sonoyta, the little party of Spaniards and Indian guides pushed on to some *tinajas*, rock pools or "tanks," which he called Agua Escondida, "hidden waters." These are the famous Tinajas Altas of later travelers. Here the Spaniards counted "30 naked and poverty-stricken Indians who lived solely on roots and lizards."

They said that if we were not back "out" in seven days, they would start "in" for us. Heading the trusty convertible south over a faint trail, Randy Gunter and I bounced and bumped along at four miles an hour in a car whose usual cruising speed was sixty. The car was equipped with oversize tires—for the sand we had been warned about. In a few hours we reached the northwestern portion of the old trail—the Devil's Highroad.

It took us the whole of the first day to reach Tinajas Altas from Wellton, a distance of only 27 miles.

ALTAS
WELLTON
TULE WELL
TULE TANK 1600

Some of this time, of course, was spent in cutting brush and putting it under the tires, deflating and reinflating the tires, shoveling, pushing and fighting in the hot sun to get the car through the treacherous sand washes that abound in this lonely and untraveled country. (And also we did spend some of this time just cussing.)

Late that afternoon my companion shouted, "There it is!"

The faint tracks we were following turned in toward the mountains. At the foot of a steep granite cliff there was an old, bullet-riddled sign.

We had reached Tinajas Altas.

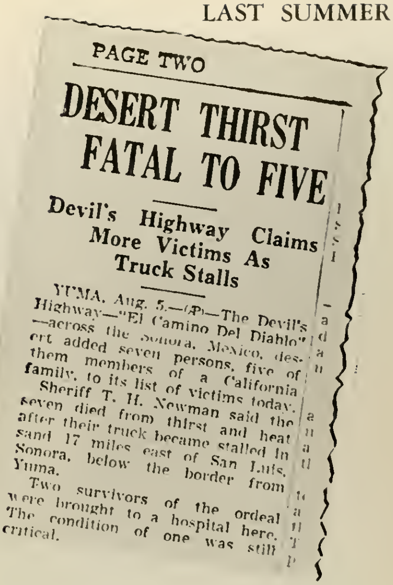
Tinajas Altas is a little cove in the great granite mountains. It is a small canyon leading up to a steep, smooth watercourse where there are "usually" water holes in the rocks. Up higher, above the water holes, is a "hanging valley," typical of this particular mountain range. This hanging valley is a geological indi-

Highroad

By

SHERMAN BAKER

LAST SUMMER



PAGE TWO

DESERT THIRST FATAL TO FIVE

Devil's Highway Claims More Victims As Truck Stalls

YUMA, Aug. 5.—(AP)—The Devil's Highway—"El Camino Del Diablo" —across the Sonora, Mexico, desert added seven persons, five of them members of a California family, to its list of victims today.

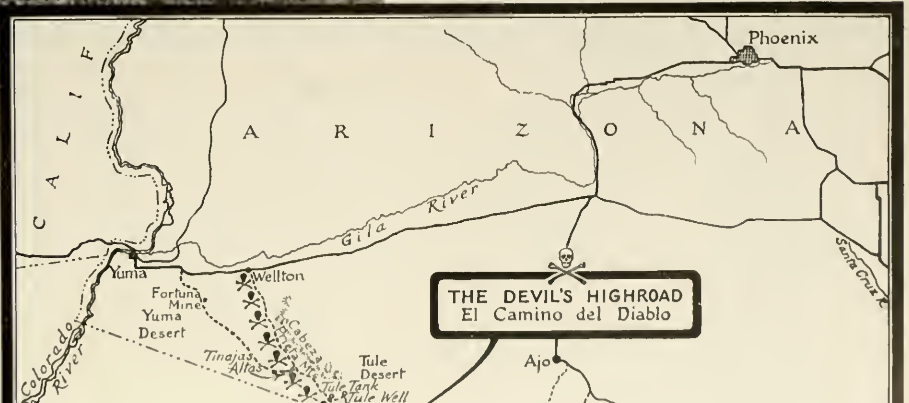
Sheriff T. H. Newman said the seven died from thirst and heat after their truck became stalled in sand 17 miles east of San Luis, Sonora, below the border from Yuma.

Two survivors of the ordeal were brought to a hospital here. The condition of one was still critical.

Photographs by the author taken specially for NATURAL HISTORY Magazine

(*Left*) A SCENE NEAR the center of the merciless desert road in southwestern Arizona, on which Government expeditions have found as many as 65 graves in one day's horseback ride. In one spot an entire family had died of thirst within a few yards of one another. The bullet holes on the signs may well symbolize the feelings of travelers for the miles ahead they dread

FIRST TRAVELED in 1699 by Spanish priests, the Devil's Highroad lured later travelers as a short cut to the gold of California. Near it too was found a nugget of pure silver, weighing over one ton


Phoenix
ARIZONA
CALIF
Gila River
Santa Cruz R
Yuma
Wellton
Fortuna Mine
Yuma Desert
Tinajas Altas
Cabeza Prieta Mts.
Tule Desert
Tule Tank
Tule Well
THE DEVIL'S HIGHROAD
El Camino del Diablo
Ajo
Papago Well
Organ Pipe Cactus National Monument
Colorado River
MEXICO
0 5 10 20 30 40 50 MILES
Sonoyta
To Tucson
Levett Bradley

cation that the mountains were elevated above the plain, probably in Quaternary time.

After a preliminary climb up the smooth rock face to the water, to replace every drop we had used from our canteens, we prowled around to explore.

"Mortar holes!" my companion called, pointing toward a low rock in the watercourse. I ran over to where he stood.

"Yes, and sherds, too." We stooped and examined the abundant fragments of pottery and the deep circular holes ground by forgotten Indians in long years of corn-grinding. We found some charred bone, an arrowhead, and then a sea shell, brought by some ornament-loving Indian woman from the Gulf of Baja California.

Here we saw the strange elephant tree (*Elaphrium microphyllum*)—a primitive-looking growth that seemed like something out of another world, with its squat, cream-colored trunk, and many sharp-pointed branches of bright lavender color. The evergreen leaves resembled mesquite leaves, and were intensely fragrant, like balsam. The whitish roots of this tree twisted and writhed like great snakes among the hot rocks.

There was another shout from Randy.

"Look! Here in this cave!"

Near the water holes, in a shallow cave, there were dozens of Indian paintings, red, black and white.

The buzzards that circled overhead gave us an uncanny feeling. Everything was lonely and weird. The silence seemed to rush up and overwhelm us—a silence from the prehistoric, forgotten past. We could think of the many men, Indians, Spaniards, Americans, who died of thirst in this eerie country. And we thought of those who managed to crawl to the life-giving water, just in time—

Who were these men? Historians have but the vaguest idea. Father Kino made several trips along the Camino. First, in 1699, then in 1700, and again in 1702, with Father Salvatierra and Father Gonzales. In 1736, on the eastern edge of the Devil's Road, there was great excitement. An immensely rich, but probably shallow, deposit of pure silver was discovered. The little mining camp that sprang up was known as Arizonac, a name that was most likely the origin of the name of the present state. We have good authority in believing that the world's record silver nugget came from this region. It was a mass of pure silver with the amazing weight of 2700 pounds.

Padre Sedelmair, Padre Garces, and Captain Anza were other Spaniards who trod the treacherous trail. And in 1775 the lonely wastes of the Devil's Highroad echoed with the tread of over 200 white men—soldier-colonists for California.

From the days of the Spaniards to the discovery of gold in California there was a long period of emptiness and loneliness for this desolate road. The faint tracks in the sand were soon blown over and the little campfire sites covered up with drifting, dry dust. Year after year the parching desert wind sobbed its eternal song of desolation and of death. Year after year the bighorn sheep drank from the lonely water holes, and the rattlesnake wound its death-dealing length in the deep shadows of the rocks, unseen by human eyes.

And then came the Gold Rush.

When the lure of gold drew men to far-off California, the barren rocks along the Camino rang with the lustful tread of marching men. It was during this period of the Gold Rush that the dreaded Camino claimed most of its victims.

From 1849 on into the early 'fifties, hurried and inexperienced parties were organized in Texas, and improperly equipped, rushed headlong into the desert wastes along the shimmering, dazzling, Camino del Diablo. Without guides, without sufficient water, the gold seekers plodded along mile after mile, until their horses and cattle died from exhaustion and thirst. Then, stark-naked in their frenzy, with blackened tongues and shriveled lips, the shrunken, scorched travelers stared out of lidless, seared eyeballs at the miles of sun-blasted desert ahead of them. One after another they dropped in their tracks and died.

Sometimes other parties of gold seekers hurrying to California would stop and pile rocks over these twisted, mummified bodies. Government expeditions in recent years have found 65 of these graves in one day's horseback ride. One large pile of rocks contained the bones of an entire family whose horses gave out and who died of thirst within a few yards of one another.

Our campfire was dying down. I picked up a chunk of dead ironwood and threw it on the embers.

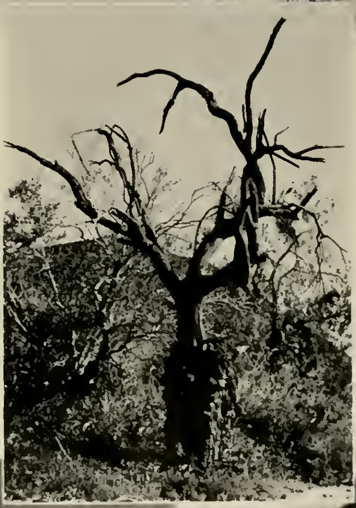
The wind sighed over the sharp granite crest above us. My friend stirred the fire with a stick. All around us we could feel the presence of these nameless, forgotten gold-crazy people who had died all along the Camino.

Right near us, here at Tinajas Altas, over 50 graves had been counted. Some historians estimate that several thousand deaths occurred along this Devil's Road during the wild years of the Gold Rush No one can ever know.

The next morning we explored the locality. It was a real oasis in the desert. During the coolness of dawn the song sparrow and the cactus wren made the air beautiful with their liquid songs. While making breakfast I saw a dove near one of the water holes.

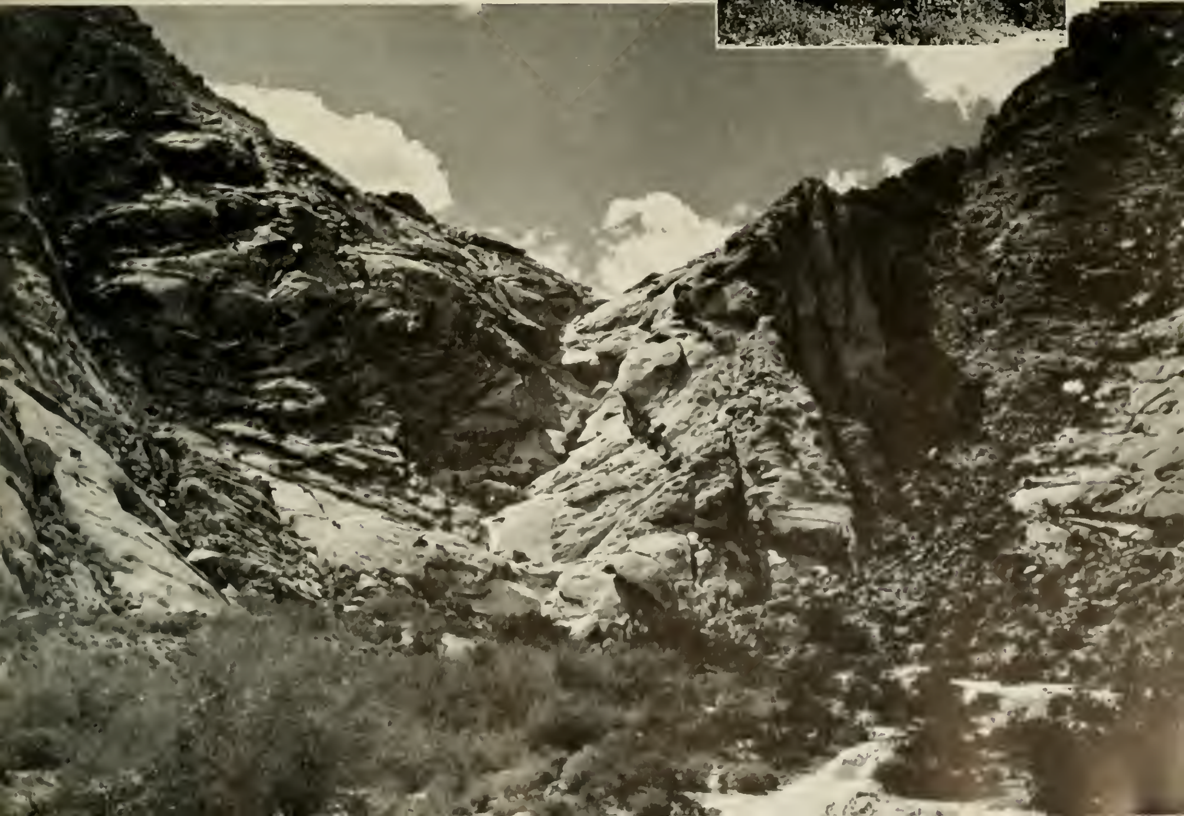
THERE'S NOT MUCH to a camp in Arizona—sleeping bags, food, a campfire, a car, and gasoline,—but one who attempts to travel the notorious Devil's Highroad must take special equipment and use careful foresight

SETTING OUT ACROSS the Lechuguilla Desert, the traveler faces many waterless miles. Loose, deep sand *(above, right)* was the greatest hardship encountered by the author and his companion in traversing the old trail



OUT OF THE PARCHED EARTH a dead ironwood tree *(right)* raises its gnarled branches against the blazing desert sky. Temperatures of 126° in the shade and 160° in the sun have been recorded on the Devil's Highroad

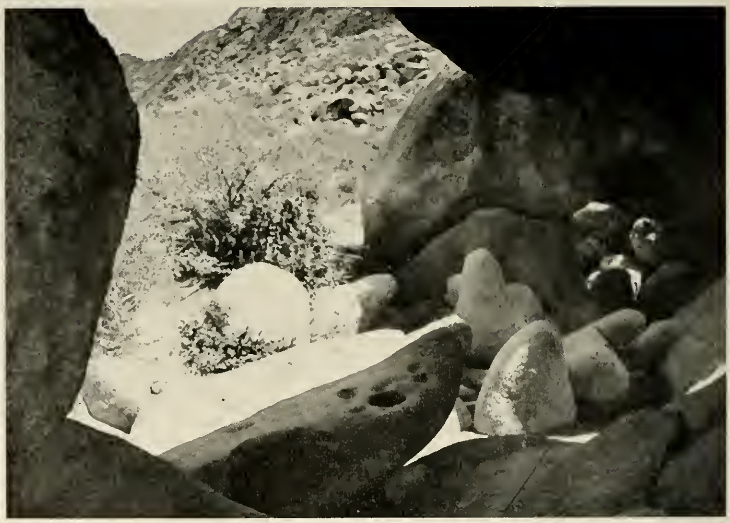
(Below) AN OASIS in the desert: Tinajas Altas, the "hidden waters" referred to by early travelers. One natural "tank" is at the base of this cove in the great granite mountains. A second and third are one-fourth the way up, and six others are at or near the top



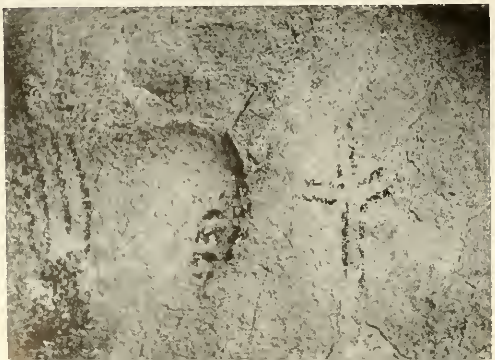
TANK TWO, a welcome basin in the rock to the desert-weary traveler, is visible beside the figure above

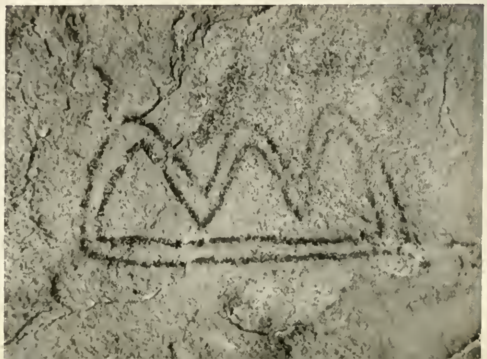
LOOKING DOWN from another point at Tank Two, with the camera at a steep angle

(Right) THE FIRST SPANIARDS to travel the Devil's Highroad found "30 naked and poverty-stricken Indians who lived solely on roots and lizards" at Tinajas Altas. Here are some vestiges of their presence: mortar holes in the rock in which they presumably ground corn. The author and his companion counted about 150 of these holes



(Below) DOZENS OF INDIAN PAINTINGS in red, black, and white decorated a shallow cave at Tinajas Altas. The travelers also found abundant pottery fragments, an arrowhead, and a sea shell doubtless brought by some ornament-loving Indian woman from the Gulf of Lower California





CREAM-COLORED TRUNK, bright lavender branches, and whitish roots twisting snake-like among the hot rocks give this elephant tree a weird, unearthly appearance

(Below) THE Cabeza Prieta Mountains gleam brightly across almost 20 miles of desert from Tinajas Altas

FARTHER TO THE SOUTHEAST the old Devil's Highroad winds through an unusual profusion of desert plants — jeweled wild flowers, pungent greasewood, and spiked ocotillo

We saw hummingbirds, mockingbirds, swallows, bees, butterflies. I heard the call of the wild Gambel's quail. And during the night a rat had done his best to finish up our supper after we had rolled up in our bedrolls. Near the water holes there were many signs of bighorn sheep, and I found a sheep horn and a dried sheep carcass. There were also wild burro tracks, and coyote tracks.

Having packed our meager camp outfit in the car and filled our canteens brimming again, we started out once more, traveling east along the Camino toward Tule Tank, the next water hole. Water was also "usually" to be found here, we had been told.

Bouncing along at our four-mile-an-hour pace we came across a curious circle of stones about twelve miles from Tinajas Altas. It was some sort of Indian ceremonial spot, evidently. Inside the circle was an anthropomorphic figure, oriented toward the north.

Then, bumping cautiously along the trail between the Cabeza Prieta Mountains and the Tule Mountains, we came to a sand wash. It was like a hundred sand washes we had easily crossed, and after a moment's reconnaissance, we started to cross it. Halfway across the hind wheels started to sink in. We stalled.

"Blow sand!"

My comrade was right. It was the dry, powdery sand, fine as dust, into which car wheels dig deeply and quickly. It was almost as bad as quicksand.

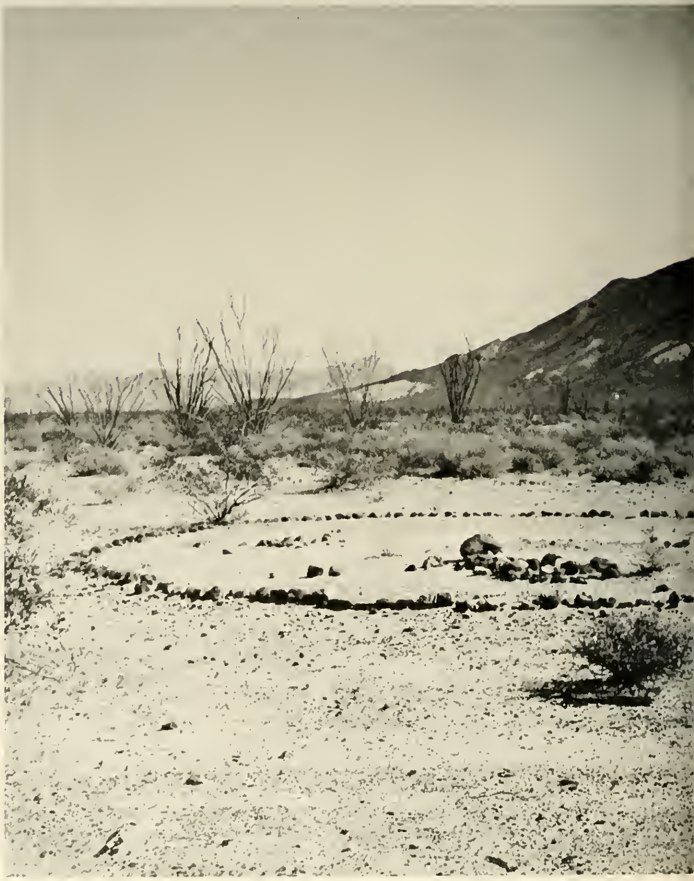
He chopped brush to put under the wheels, while I shoveled—for an hour and a half in the sun. Then we sat in the shade of the tilted, trapped car, and rinsed out our parched mouths with water. I remembered what they told me in Wellton about the last few deaths along this road. "Water," "lack of water," "drank all their water," and so on. It suddenly came to me that the radiator of our car was filled with a bright orange antirust solution. Was it poisonous? It certainly looked it.

They had told us that if we did not come "out" in seven days, they would come after us. With luck we could get along for a week, if we husbanded our water and didn't exercise.

Then we got back to work. We let most of the air out of our rear tires, laid mesquite branches across the wash and under the tires, and cut down the slope of the farther bank. Another swallow of water in my mouth and I got in the driver's seat. I started up the motor, put it in gear, and released the clutch. The car began to creep forward as the brush gave traction

(*Right*) THE AUTHOR and his companion discovered this curious circle of stones along the old trail near the Mexican border. It is apparently an Indian ceremonial place. The stones in the center form a figure in the likeness of a man

A GRANTE PEAK capped with black lava, Cabeza Prieta is well named "Black Head." Arizona's State Flower is the blossom of the saguaro (sa-gwah'-ro) cactus (*foreground*)



under the tires. The car was out, back on solid earth again!

We had a real drink of water then.

We reached Tule Tank safely and found water there—green-scummed water, but precious to us. We camped beneath a big paloverde in the dry wash. Tule Tank consisted of one large pool of green water in a hot furnace of orange rocks. It reminded me of what I had read about the Danakil country in Abyssinia.

A few miles beyond Tule Tank was Tule Well. This was dug by an enterprising Mexican in the 'sixties. Here he had built a rude house, and sold water and supplies to travelers. But he charged somebody a little too much for a drink once and was shot. The place became deserted and the water foul.

Raphael Pumpelly, the noted mining engineer, went through this "land of silence, solitude and sunshine" in July, 1861, on his way to California. He writes of the "barren and dazzling masses of rock" that assail the tortured eye on all sides. His thermometer ranged from 118° to 126° in the shade, and 160° in the sun. He noted "countless skeletons of cattle, horses and sheep . . . wholly preserved in the intensely dry air." Previous travelers, with a grim sort of humor, had propped many of these sentinels upright on their feet, and to Pumpelly "they seemed sentinels guarding the valley of death."

Having used up much more of our reserve gasoline than we had estimated we would, we decided that discretion was still the better part of valor, and that we had better come "out." So, from a little east of Tule Well we turned the radiator north, back toward the paved road.

On the way "out" there was one thing that haunted me about the Camino del Diablo. It was this: in all its varied history, in all its colorful pageantry of Indians, Spaniards, Mexicans and Americans, there was one especially terrible and cruel thing about this deathly Road of the Devil. In the Gold Rush days the gold seekers who managed to survive the worst part of the trail passed along the base of the Gila Mountains. They struggled westward, their tortured minds filled with the vision of California gold. It is the ghastly irony of the Devil's Highway that these poor gold hunters, lusting for the gold beyond the horizon, stumbled blindly within a few hundred yards of what is now known as La Fortuna Lode. La Fortuna Lode in recent years has been developed as one of the richest gold mines in the West.

THE DEVIL'S HIGHROAD

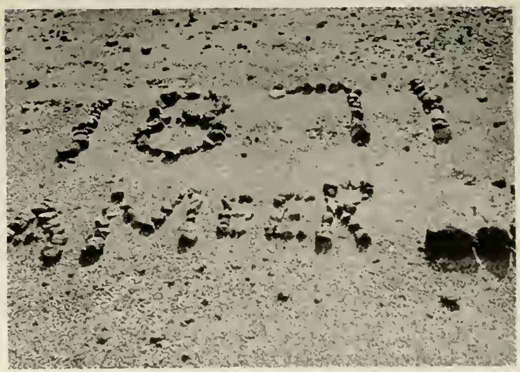


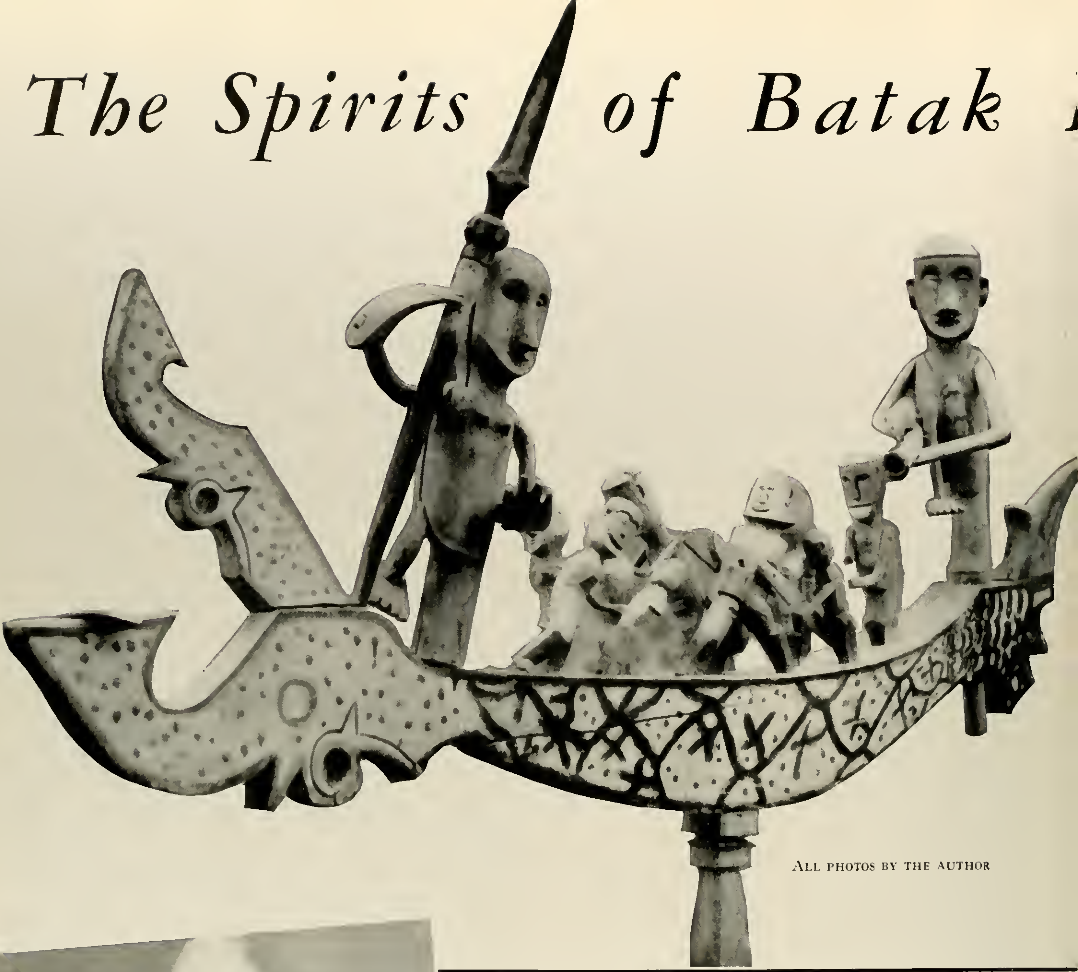
Photo by Tad Nichols

A GRAVE on the Pinacate Lava, east of Tule Well

(Below) IN A NETWORK of slender green lines the sparse vegetation south of Tule Tank shows clearly the watercourses in this arid land

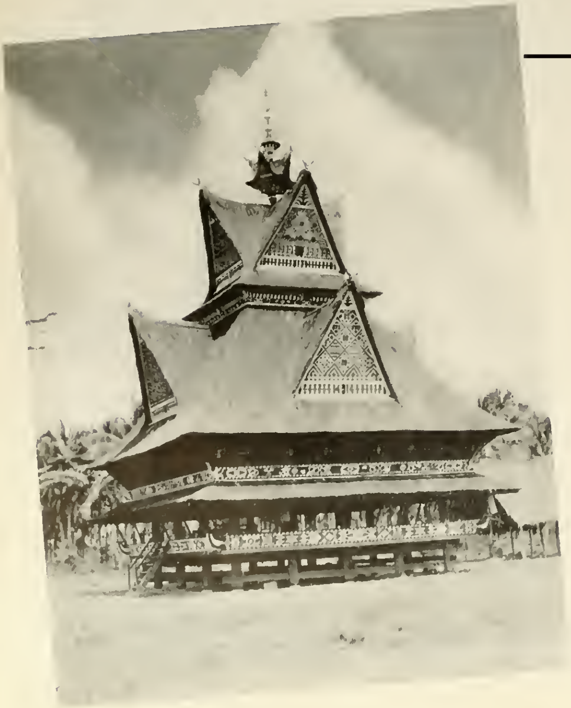
Photo by Tad Nichols

The Spirits of Batak



ALL PHOTOS BY THE AUTHOR

THE BATAKS OF SUMATRA believe that their early home was in some other land. Therefore when bad times visit them it may be because the dead wish to go to their ancient home. Then their bones are dug up, and a chip from each skull is put in a miniature boat, along with wooden images of the dead, as shown above. All assemble beside the nearest river, and the boat is launched. Voices wail but hearts secretly rejoice as the ship sails away with its ghostly passengers, to carry them to the ancestral land, where they will no longer trouble the living



AGAINST their background of primitive savagery, the Bataks of Sumatra astonish the visitor with flashes of high artistry. The beautifully decorated building at left is a guesthouse in which any wayfarer may sleep. Note the bullock heads on the gables, which indicate the number of animals sacrificed to the spirits when the house was built. Human sacrifices were formerly made

nd

By WILLARD PRICE[*]

"Don't look now, but something is following you." In the large island nearest to Singapore, one must invent special languages that the spirits cannot understand and take a multitude of other precautions against the rulers of the unseen world

THE TIGER'S SPIRIT is feared above all others. When a raja killed this marauder, elaborate ceremonies were necessary to avert the wrath of all the tigers, who dwell in a tiger city, in houses thatched with women's hair

WE sat on the floor and waited for the tiger. The wavering light of the candle threw great shadows upon the smoke-blackened walls and high roof of the Batak house.

The Dutch schoolmaster, Pieter van Blok, sipped his tea. I toyed with my rice and listened for the step of large padded feet.

But I believe the young king was the most uneasy of the three of us. For he had more than the tiger's jaws and claws to fear. He, being a Batak, stood in dread of the tiger's spirit; for the Bataks believe that of all the evil spirits which inhabit rock and tree and animal, the most terrible live in the tiger.

He was raja (king or chief) of a small Batak village in the island of Sumatra. I was a traveler in search of ethnological facts, and the Dutch schoolmaster, who knew the Bataks well, had volunteered to be my guide through this fascinating country of tigers, orchids, ex-cannibals and—spirits.

When we had asked permission to stay the night in the king's house he had warned us that it might not be a very good night. Recently a tiger had been making frequent visits to the village. It had come under the king's house and stolen some of his chickens. It had come again and devoured a litter of puppies. On its third visit it had leaped up the short ladder into the house itself, seized the king's favorite dog and made off with it. Once more it had come, plucked a child from the street, and carried it screaming, into the jungle.

The village elders met and agreed that the king was justified in killing the tiger. This was a very grave decision. The malevolent spirit of the tiger might stay in the village to sow sickness and death.

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[*] The waters now geysering with bombs and the island peoples who live in the great Pacific area are an old story to Willard Price, author, editor, and traveler. As a student of world affairs and of native peoples he has investigated the natives of Mindanao, Sumatra, and elsewhere, in addition to the Japanese, on whom he is an acknowledged authority. His latest book, *Barbarian,* appeared almost prophetically on the eve of action in the Pacific. It is a historical novel, opening with Commodore Perry's advent and Japan's wholesale adoption of Western ways. It traces the subsequent reaction against foreigners, the return of Japan to a mental feudalism, and the abandonment of democratic methods for totalitarian. The book is called *Barbarian* because that was the epithet applied to foreigners. Mr. Price's vivid and timely article here gives NATURAL HISTORY readers a cross section of the peoples of Sumatra without attempting a detailed analysis of customs by locality.—ED.

(Left) THE FIRST STEP in the making of an automobile tire: a native cutting a groove in a rubber tree. In orderly rows the plantation trees here and there displace Sumatra's forest primeval

At right, the cup is placed in position to catch the latex

Or he might fly to the tiger city which is supposed to exist in the depths of the jungle. There the tigers live in houses and govern themselves like men. The spirit of the dead tiger would enter the council chamber of the beasts of the tiger city. It would tell what had been done, and all the beasts would descend upon the village to avenge their dead comrade.

So the village elders made their decision with fear and hesitation. They did not even use the word "tiger," nor did the king when relating these events to us. Roundabout terms are always used in referring to the most dreaded beast in the Sumatran jungle. It is apparently hoped that the tiger spirits, who may be listening, will not understand that the terms refer to the tiger. He is evasively called "the grandfather to whom the wood belongs" or "the old one" or "he with the striped coat."

The young king had gone to a near-by American rubber plantation and borrowed a trap. That trap was now under the house. Beside it was tied one of the village curs. We heard him whining softly. The king listened, his hand on his gun.

"Pardon"

We sat for two hours thus, hardly breathing. Then the dog's laments suddenly rose to a scream. There was the snap of steel, a thunderous roar of pain and a great thrashing about. The king gripped his gun and went down the ladder.

We followed and played a flashlight into the gloom under the house. Two eyes burned like green flames. We waited for the king to fire, but as he took aim he pleaded with the spirit of the beast to pardon him for what he was about to do. Then he fired and the tiger slumped dead. The shot was too much for the already frayed nerves of the dog, who broke his cord and fled, howling.

Villagers swarmed down from the stilted houses and came running. Everyone talked at once. After much palaver, they went gingerly under the king's house and dragged out the carcass.

They put it in the place of honor, the center of the open space before the king's house which stood at the heart of the village. Lanterns were brought to light the scene. The tiger lay with his head between his paws, a picture of great dignity, even in death. Offerings were placed before him, grains and meats and flowers.

Incense was set to burning, and a gnarled old medicine man intoned prayers in a loud voice.

"He is praying that the spirit of the tiger may enter the incense and pass away," the schoolmaster said. "And now he is addressing a prayer to all the spirits of the forest. He is explaining to them why it was necessary to kill the tiger. He is begging them to intercede with the tigers of the tiger city so that they will not come and attack this village."

When the long prayers were done, the people began to dance. They circled round and round the carcass. It was not, as one might have supposed, a dance to celebrate the killing of the monster that had preyed upon their village. It was a dance in honor of the tiger's spirit. If that spirit were not mollified, there would be terrible consequences. It was a dance of dread. It continued until dawn.

Dread of the unseen is the chief force governing the lives of the Bataks. As we went on through the villages, Pieter van Blok lamented the lack of schools and the multiplicity of charms, talismans, shrines, thorns projecting from the corners of houses to catch prowling spirits, knives over doorways to impale them before they could enter the house.

Animal sacrifices

Many of the houses are guarded also by the threatening horns of bullocks and buffaloes, whose heads, carved from wood and brilliantly painted, are mounted on gables and cupolas. Their number represents the number of such animals sacrificed when the building was erected. They are a notification to all the spirits that roam the air that the tax of homage to the spirit world has been paid, and immunity purchased. The spirit that would ignore this receipted bill and enter the home to demand a new accounting, would be an evil spirit indeed. Yet this sometimes happens. One of the occupants of a house that fairly bristled with horns said:

"They don't really do much good. It was different in the old days when human sacrifice was made. The spirits were satisfied with that. But the sacrifice of animals is not enough."

Human sacrifice is almost a thing of the past. Human heads are no longer placed under the foundations of Batak houses. This is because the Dutch Government sternly forbids it. Deprived of their custom to practice human sacrifice, the Bataks have created a fantastic folklore about their rulers and believe that the Dutch themselves insure the safety of their buildings in the same way. It is village rumor that the government employs a man who goes about getting heads to place under the foundations of bridges, government buildings, and other public works. He is the bogeyman by which Batak parents terrify their children into obedience. "If you don't do as you are told, he will take your head for the new bridge."

Nor is this belief entertained only by the most ignorant. "The boys in my school have the same notion," said Pieter. His school was not in these wild highlands but down near the ocean's edge in the progressive city of Medan.

Beautiful and productive

Sumatra is in two levels. People of all nationalities live in the steaming coastal towns. The wild tribes have the cool, bracing air of the interior plateau, 4000 feet high, very much to themselves. It is a land of beauty. Active volcanoes toss their white plumes into the sky. A great lake of the sky, Toba, lies cradled in the mountaintops. It is a land of tall timber: oak, camphor, and teak. Here and there the forest primeval has been displaced by orderly rows of rubber trees owned by American or other foreign interests. But they have made little dent upon the jungle. Sumatra is unsurpassed for interesting fauna. Close to the villages hover the tiger, panther, tapir, rhinoceros, elephant, buffalo, deer, and several species of ape.

The Batak village is often surrounded by a high wall made of sun-dried mud. Sometimes the only entrance is by way of a ladder over the wall. If there is an opening in the wall it is apt to be blocked by a stile over which you must climb.

It is impossible to enter unnoticed. Your advent is heralded by dozens of dogs.

The houses stand on stilts and lean forward as if about to walk off. They wear hoods of thatch built high and narrow to shed the frequent rains. The inside is dark except for a beam of light through a hole in the gable and another through the open door.

The ordinary house has a fireplace in each corner, and on each side of the fireplace lives a family. That means eight families in a house. The pigs and chickens live underneath. A Batak residence, when everybody is at home, is not a quiet place.

Some of the houses are beautifully decorated. The Batak, in fact, astonishes the visitor with flashes of culture on a background of primitive savagery. Since before the Christian era, Hindu influence has been felt in Sumatra. Later, some tribes were touched by Islam. But the Batak resists foreign influences. His way of life is essentially his own. His science and philosophy and religion are all compassed in one word —spirits.

Spirits explain everything. "Batak boys and girls are bright, and learn easily," Pieter said. "But the adults are so settled in the theory that crop failures and epidemics and all other ills are due to spirits that it is hard to open their minds to natural causes." Earthquake, eruption, thunder, lightning, wind, rain —all are explained in the same way. In a sudden violent storm which threatened to blow down the houses of a village, we saw the people rush out with swords and spears and slash the air, meanwhile shouting at the tops of their lungs, to frighten away the demons of the tempest.

"Camphor language"

Not only all animals are the homes of spirits, but all trees and plants. The white lumberman who tries to use Bataks as lumberjacks is soon in trouble. For example, there are rigid ceremonies to be observed in the cutting down of camphor trees and extraction of their crystals of camphor. First a flute must be played to calm the spirits of the trees. Then the workmen lie down to dream in which tree the best camphor may be found. The white boss may fume and rage but their sleep must not be disturbed. Finally they rise and, with elaborate delay, select the tree. They generally choose well. During all this time they are using "camphor language." Common terms are replaced with roundabout expressions. The idea is to conceal from the spirit of the tree the fact that he is about to be attacked. If he knew, he might fly while there was yet time, and that would mean that no crystals would be found in the tree.

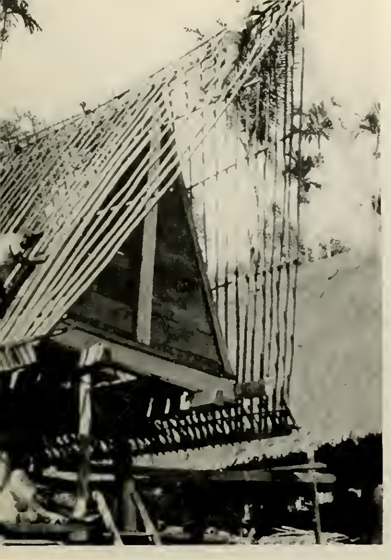
Now they begin to chant apologies to the camphor spirit, every apology being accompanied by a blow of the ax. When the tree falls the top is instantly wrapped in cloth so that the spirit may not escape. Then the log is split and crystals are picked from the cavities in the wood.

The spirits of all trees receive most special respect from the Batak. Perhaps this is because of the unique beauty and personality of the tree as compared with all other growing things. Not only the sensitive Joyce Kilmer but also these ignorant jungle savages are quick to recognize the living individuality of a beautiful tree. When he must cut one down, he offers the tree spirit a quid of betel and profound apologies. If he later finds sap oozing from the stump he concludes that the spirit is weeping and he propitiates it by the sacrifice of a chicken.

When men are clearing a road through the forest and come upon some magnificent tree which must be annihilated, they spare no effort to make it clear to the spirit that not they themselves but their Dutch overlords are responsible for this dastardly deed.

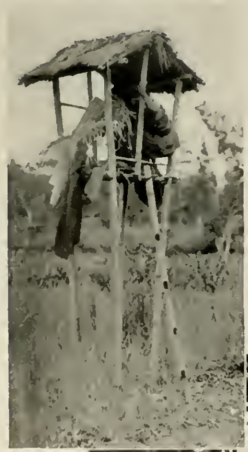
A young tree is sometimes planted near the stump of a fallen giant to serve as a new home for the evicted spirit. Offerings of betel and money also help to soothe the spirit's lacerated feelings so that it will not be so likely to avenge itself upon its tormentors.

Not only trees but many plants are the abodes of spirits. The ghostly inhabitants of the plants have various powers over human beings. Usually their influence is evil, sometimes good. A branch of the "like iron" plant hung over a sleeper's head will make him



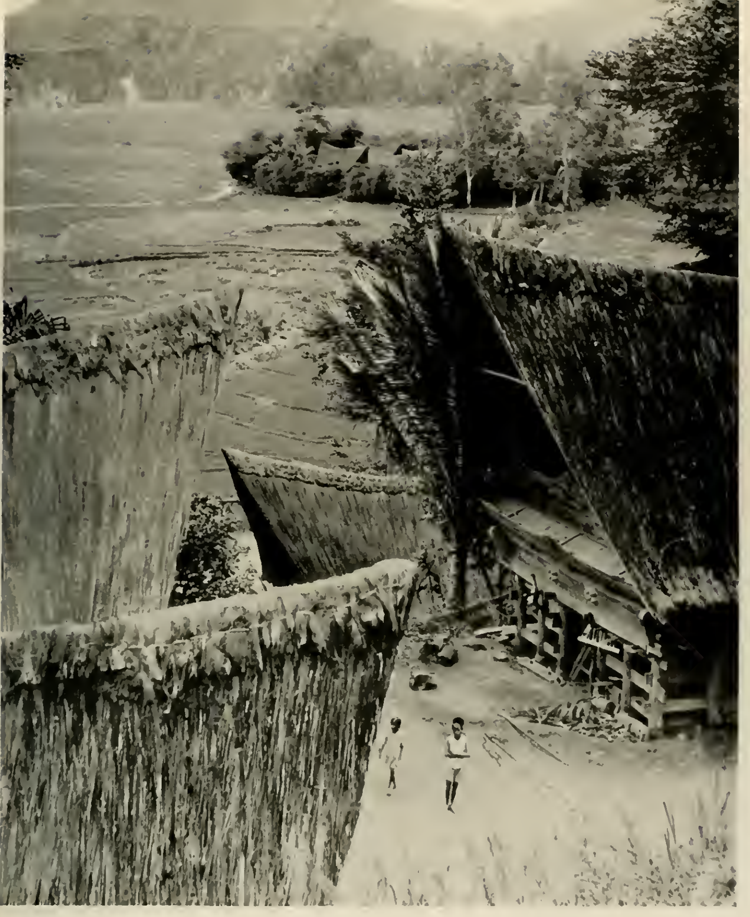
(Left) THE PICTURESQUE BATAK roof in process of construction. The houses stand on stilts and lean forward as if about to walk off. The high-peaked hood of thatch is effective in shedding the frequent rains

(Right) BEAUTIFUL BATAK LAND is a country of sweeping valleys and tall timber. Camphor and teak are found in its forests, and active volcanoes toss their white plumes into the sky

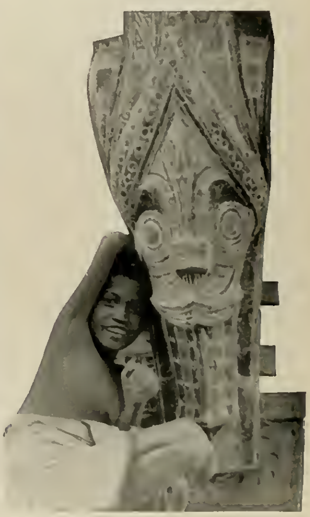


(Left) IN HIS WATCHTOWER overlooking the rice fields, the operator of the scarecrow manipulates his apparatus like a long-range puppeteer. He has cords running to scarecrows in all parts of the field, so that when a bird alights he has only to pull the right string

(Below) THIS BATAK VILLAGE in its grove of luxuriant trees is like an island in a sea of rice fields. The spirits of all trees receive most special respect from the Batak

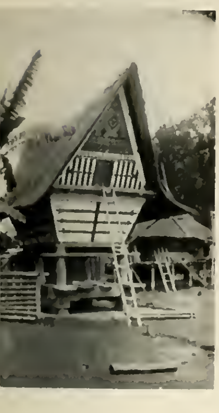


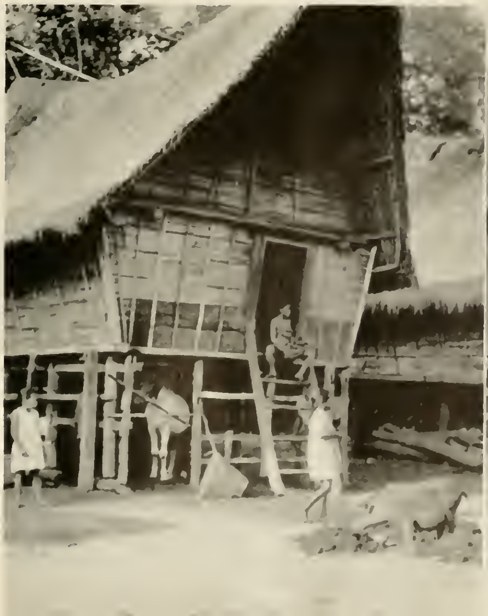
(Left) A VILLAGE OF BATAK LAND overlooking a rice field, from which rises another island of greenery with its sheltered houses



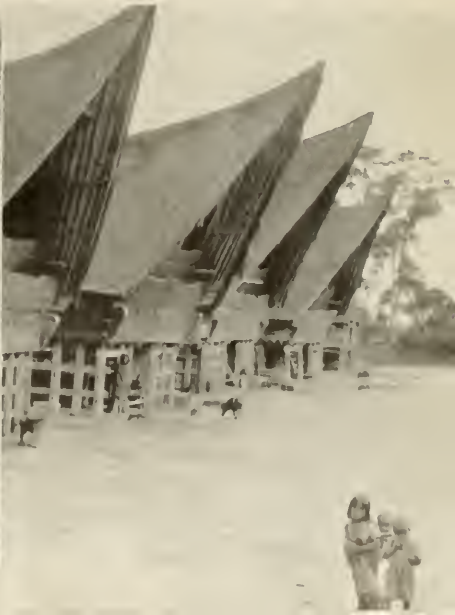
(Above) SOME BATAK HOUSES have elaborate and skillful decorations. Since before the Christian era, Hindu influence has been felt in Sumatra. Later some tribes were touched by Islam

(Below) A HIGHLY ORNAMENTAL rice house. *(Below, center)* A typical dwelling, showing how everything that cannot be gotten into the home is put under it—including cattle





(Below) THE HOUSES of a Batak village thrust their pointed roofs skyward like the bows of ships in drydock. High walls of sun-dried mud often surround the villages



as strong as iron. It is used as a remedy for fever, because iron is cold. It is a cure for an inferiority complex, and will build up personality and make a man a power among his fellows, because iron does not yield.

Some of the spirits of the dead take up their home in plants. In the village of Hoeta Gindjang near Lake Toba we asked a man to take us to the raja.

He took us through the village. We expected to be led to the finest house. Instead, he presently stopped before a large bush bearing lovely red flowers.

"The raja died two years ago," he said. "He now lives here."

In the exquisite and kingly *sepatu* flower the soul of the dead ruler is supposed to live on. Lesser souls transmigrate into lesser plants.

Ancestral spirits

The souls of the dead are man's chief enemies. It is strange that he should fear most the spirits of his own relatives and friends with whom he was on the best of terms while they were alive. Why should a good man in life become a bad man after death? The Batak's explanation is simple. The souls of the dead depend upon the living for everything. If the living do not make offerings of food, recite prayers and go through ceremonies, the dead will starve, be humiliated among their fellow spirits, and perish horribly. The spirits demand so much attention that it is impossible to give them enough. Therefore the spirits are conceived of as being resentful of the lack of honor paid them and resorting to every means to punish the living.

When the ancestors refuse to be satisfied with what is done for them and inflict too many troubles upon the living, the villagers join forces and hold a great feast in honor of the dead.

If adversities continue, an effort is made to ship the ancestors out of the country. The Bataks have a tradition that their early home was in some other land, whence they came to Sumatra. It is assumed that the spirits of their dead relatives may wish to go to the ancient home of the race to join the great company of the spirits of former Batak generations.

The local artisans build a miniature ship. A wooden image of each of the village's most recent and more annoying ancestors is roughly carved and placed upon the ship. Gravediggers exhume the skeletons of the ancestors, take a chip from each skull and put the chips in an earthen jar on the deck of the vessel. Then all assemble on the banks of the nearest river for the ceremony of farewell. Voices wail and hearts secretly rejoice as the ship is launched and sails down the river with its ghostly passengers. The belief is that it carries them to the sea and across it to the ancestral land. There the old ones are expected to be happy and trouble the living no more.

The demons of disease

But the demons inhabiting earth and wood and sky are not so easily banished. When a man becomes ill an effort is made to dispel the demon that is tormenting him. The medicine man fashions a figure of the sick person from a banana stem and dresses it in male or female attire, according to the sex of the patient. Then he conjures the disease demon out of the patient into the image, and destroys the latter.

The medicine man is usually a great character in the village. He exercises a little shrewd common sense and a great deal of hokum. He is usually too intelligent to believe in all of his own remedies. The temptation to trade upon the blank ignorance of his people is too much to resist.

He uses cucumber as a remedy for smallpox, for no better reason than that the native word for cucumber, *gundur*, rhymes with the word for withdraw, *mundur*. If a whole village is overtaken by an epidemic of this disease, the Dutch Government of course becomes active, and more scientific remedies are employed. The people, however, do not take kindly to modern medical practice. They still place more faith in cucumbers. Accordingly these vegetables are in great demand during an epidemic, and pour in from all surrounding villages.

Another remedy, which has now happily passed into disuse, was prepared by the medicine men from the heart and liver of exhumed children too young to have teeth. Parents buried their infants under the steps of the house so that it might be more difficult for the medicine men to steal their remains. Such a medicine was also made from the heart and liver of slaves who were killed for this purpose. The medicine men are still at work in Sumatra, but they have resorted to less gruesome remedies.

For many kinds of sicknesses, including the sickness of love, it is not necessary to take medicines of any kind, but merely to worship a sacred jar, known as a *balanza*. This is most efficacious in bringing a recalcitrant sweetheart to terms. It also has an excellent effect upon the crops.

Another magic device more commonly used by the Menangkabau people of central Sumatra, but occasionally employed by the Batak, is the bull roarer. This may be made of wood, or better, of the frontal bone of an especially courageous ancestor. It is so designed that when whirled round and round it gives out a roaring sound. The demons do not like it.

Disease flies before it. It can be used not only to cure one's own troubles but to make trouble for others.

For the lovelorn

The rejected lover may seek revenge by means of the bull roarer. He must first get some of the offending woman's hair, and attach it to the instrument. Then the roar of the whirling slat, and the swish of the hair, is accepted by the demons as a command to wreak vengeance upon the fair one. They steal her soul, and she goes insane.

Perhaps the most extraordinary source of magic power in Batak Land is the tombstone of two Americans. In the depths of the forest near Taroetoeng stands a black monument erected by the Rhenish Mission to the memory of two American missionary-explorers who were devoured there by Batak cannibals. Upon the face of the monument appear the following words in German: "Here rest the bones of the two American missionaries, Munson and Lymann, killed and eaten in the year 1834."

The weird gloom of this place, the half-suffocated murmuring of a hidden brook about the terrible deeds of other days, the penitence of Christian Bataks for the crimes of their forefathers, all combine to give this monument an eerie significance. Bataks make annual pilgrimages to the spot. They kneel before the monument and beg forgiveness. They touch it to receive its mysterious power. They bring their sick and maimed to be cured. The Rhenish Mission, of course, frowns upon all this. But the centuries-old background of animism in the history of the Bataks is not easily dispelled.

It is probable that the two American missionaries were eaten because they were admired. Batak cannibals did not eat human flesh for the sake of the vitamins, nor for revenge. They hoped by eating the flesh to absorb the spirit. To become brave, eat a brave man. To become wise, eat a philosopher. To rule over others, eat a king. Enemies were killed but not eaten unless they were respected. The most tender flesh was that of the lowland men who lived soft lives,—but the Batak epicure preferred the hard muscles of highland men for, though tough, they were good for the soul.

The brain of the father or the heart of the mother would be eaten by their children in order to acquire their virtues. The aged looked forward to being eaten upon death. It was a mark of great honor. When an old man felt that he had about completed his span and should now distribute his accumulated knowledge among his fellow men, he would, if he had the courage and strength, climb a tree and fall to his death from the branches as ripe fruit falls. The assembled villagers would then banquet upon his wise old flesh.

In addition to the spirits of dead relatives and the spirits of stones, flowers, trees, and animals, the Batak must reckon with his own spirits. He believes that within him dwells not one soul, but from three to seven.

There is, however, a principal soul upon which life depends. If it absents itself from the body, weakness and sickness result. If, in roaming afar, it gets into trouble with more powerful spirits and is destroyed, its owner dies.

A hiding place for the soul

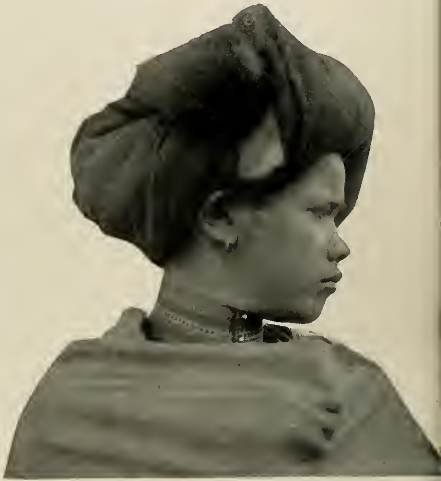
The chief soul, when at home, resides in the head, and great care must be used not to frighten it away. The shears of the barber terrify it. Therefore the barber in cutting the hair of a small boy, will commonly leave a patch uncut so that the soul may have a hiding place. When the boy reaches manhood, his soul has gained sufficient courage so that this precaution is unnecessary, and all the hair may be cut off.

The foreign photographer is the bane of the orthodox native. The Batak believes that to be photographed shortens one's life. This is based upon the theory, held by many primitive peoples of the world, that the image received by the camera is really one's soul, which is thereby placed under the control of the photographer.

Another way to entice a man's soul, or one of his souls, out of his body is to have him give you his name. The name of a man is regarded as part of his own soul-substance. If it passes through his lips he surrenders himself with it. Young men trained in modern schools did not hesitate to tell us their names. But whenever we put the question to a man of the older generation, he would call a friend to give us the required information.

Curiously enough, with the influx of modern science, the number of spirits increases. The Batak, gazing in wonder at the sewing machine, does not doubt that there is a spirit in it. It is obvious that a very powerful god lives under the hood of a motorcar. A genie speeds back and forth through telephone wires, and another with large ears sits in the radio receiver repeating messages he hears through the air. Naturally the few young men who are so fortunate as to get an education speak scornfully of the oldsters' belief in spirits,—but they themselves are sometimes caught making furtive offerings to the unseen on the principal that "it will do no harm!"

(Left) Bataks bargaining in the open-air market

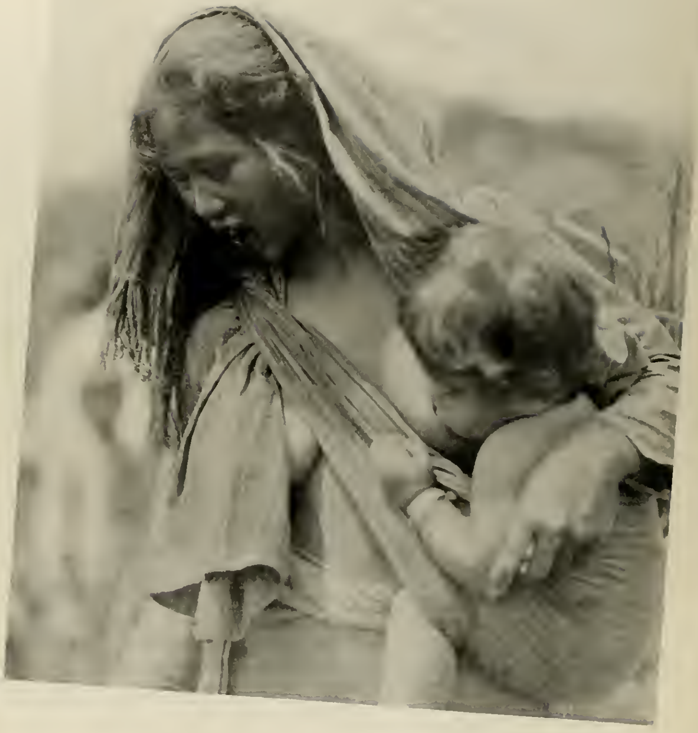


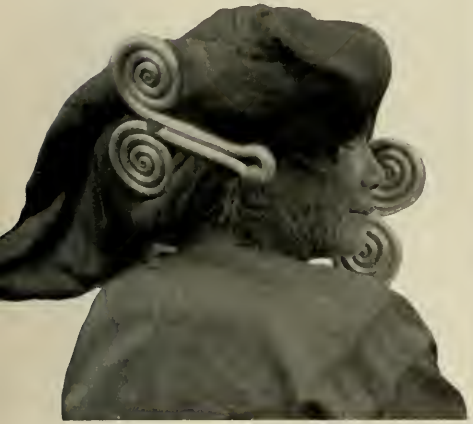
(Above) The large pillow-like headdress worn by this Batak woman is characteristic

(Below) A native woman of Sumatra winnowing grain. The chickens are raised for food and also for sacrifice, for their ceremonial death is believed to be pleasing to the spirits

Native types. The orthodox Batak believes that to be photographed shortens one's life

(Right) MOTHER AND CHILD can go where they please with the practical shoulder-sling

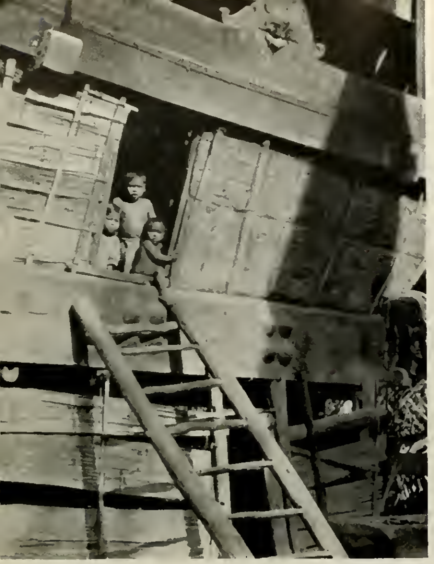




BATAK EARRINGS are passed through the lobe of the ear but are so heavy that they must also be fastened to the headdress

(Below) A BATAK WOMAN pauses amid the din that frequently reigns where natives gather for conversation

(Below) A HUSBAND kindly lifts a basket of earth to his wife's head

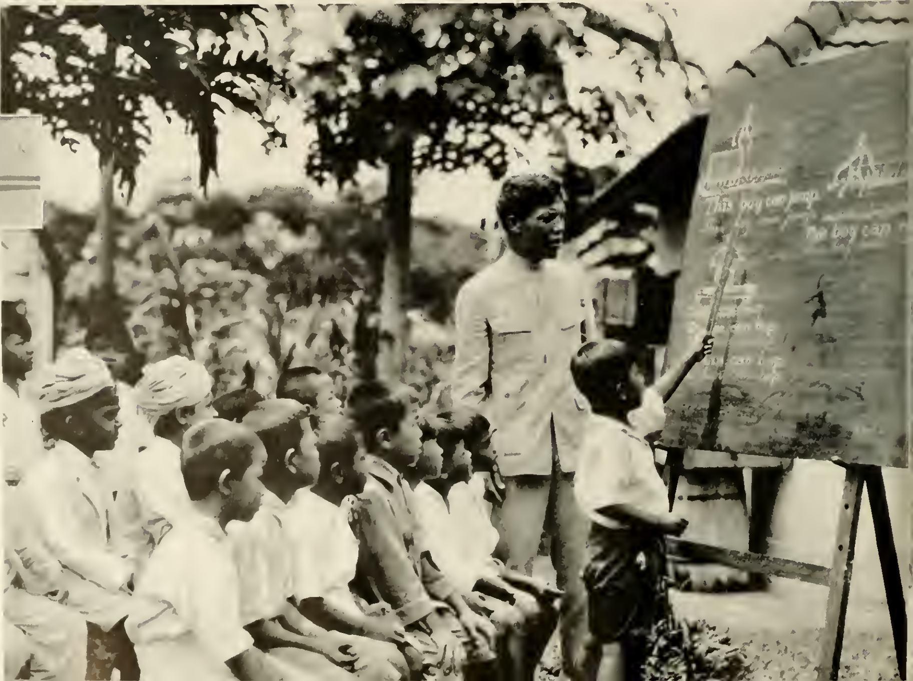


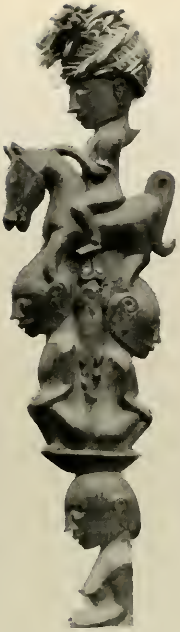
(Above) Each Batak house is expected to accommodate eight families

(Above) Trees are believed to be inhabited by spirits. When a coconut falls, it does not fall of its own accord. It is tossed down by a kindly spirit—or an evil one if it hits some villager on the head

(Left) Old enough to carry his little brother

(Below) Batak boys accept the new learning eagerly yet part reluctantly with the old idea of a world run by spirits. Note that English is taught the boys in this mission school. Six other Methodist Episcopal mission schools likewise teach English, and about 20 more teach the Malay language or Batak. The Government schools teach Dutch in the cities and the native tongue in the jungle

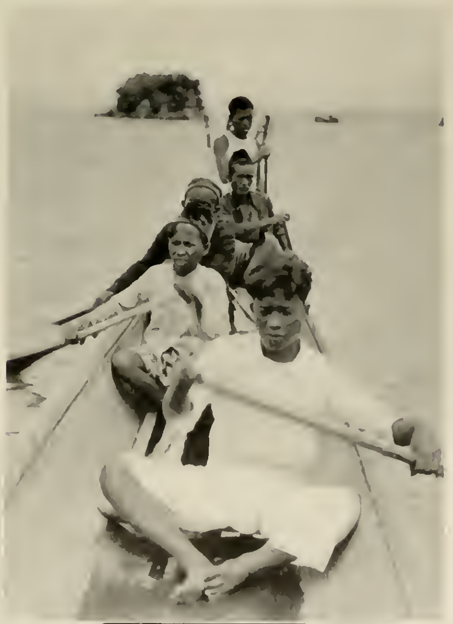


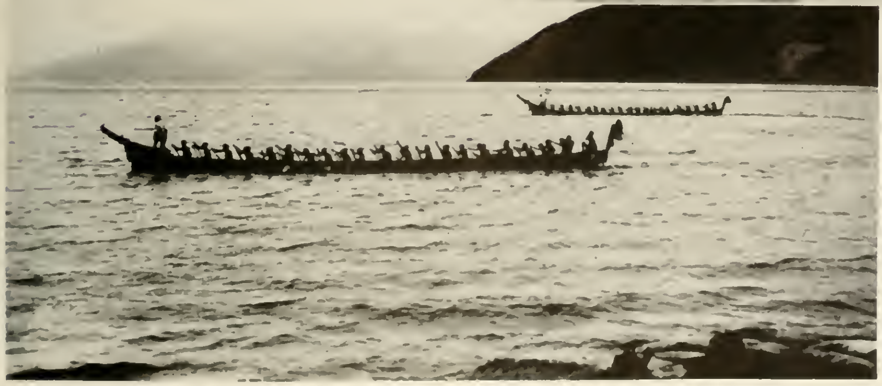


(Above) AN EXAMPLE OF THE WOOD CARVING ART in Sumatra: an elaborately carved head of a witch doctor's staff

THE AUTHOR asked to be taken to the raja in a certain village. Instead of being led to the finest house, he was stopped before a large bush, bearing lovely red flowers. "He now lives here," said his guide. Having passed away, the ruler was believed to live on in the exquisite and kingly *sepatu* flower *(above)*

(Below) CANOES on Lake Toba, a veritable lake in the sky, which lies cradled in the mountaintops. *(At right)* The paddlers in action





STRATEGIC METALS

NUMBER I

TIN

There's nothing "tinny" about a strategic metal currently selling at over four times the price of copper and likely to have a profound effect upon our immediate future as a nation at war

By FREDERICK H. POUGH

Acting Curator, Geology and Mineralogy, The American Museum of Natural History

No longer is "tin" a term of opprobrium and derision, the epithet of the truck driver for the small car; no more is "tin" the epitome of flimsiness and shoddy work. To the youth of today tin should be a thing of merit, not to be lightly bandied about. For this metal now has the blessing of the Government and the War Department as a *strategic* mineral, by which is meant, in the broadest sense, a material essential to industry, either military or civilian, of which the domestic supply is insufficient.

Strange to say, the metal which long has been symbolic of inferiority is almost lacking in the rich resources of the United States. We have ample iron, tons on tons of coal, phosphates to fertilize the farms of the world, and gold to bury in the hills of Kentucky. But the paper-thin film of the tin we put on our cans and the foil for the toothpaste tubes of the world's best-brushed teeth, must be bought in foreign markets.

Tin is not a cheap metal, it runs about fifty cents a pound—as compared with copper at twelve cents, lead at five, and zinc at seven. But it is used economically. The tin layer on the tin can is pretty thin, and today is made even thinner. Tin is used in metal bearings, the places in a motor which support and hold the turning crankshaft. These are the most important uses of tin. Recent developments have shown that other materials, among them cadmium, can be substituted for tin in bearing alloys. But bronze and true tin foils still use much of the metal, and many of the substitutes which might be developed are found upon the strategic list themselves. So tin is still essential, and with the war it will stay so, becoming ever more precious as our sources and sea lanes are threatened.

AMNH Photo by Coles

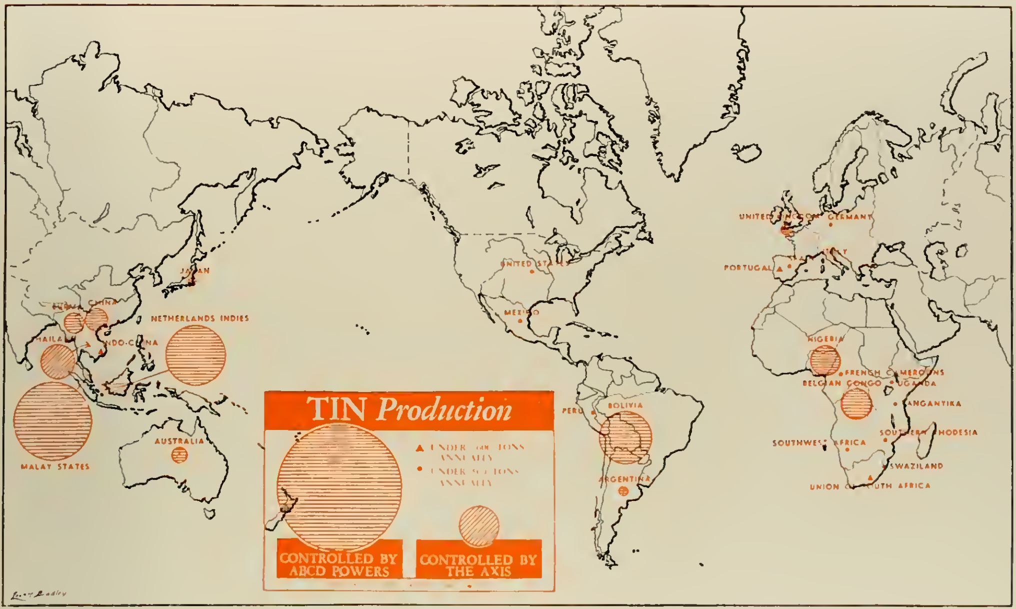
Two types of tin ore: *(left)* a knob of "stream tin" from Mexico, and, *(right)* a cluster of cassiterite crystals from a Bolivian mine

Most tin must come from ore that is newly mined, unlike some minerals that come back over and over to be re-refined, appearing again and again in new guises, like the rubber of old auto tires. Of course some tin is recovered from tin plate scrap, but gathering old cans and skinning the thin layers from them has not proved profitable. So we must rely for most of our needs upon new supplies.

Cassiterite is the only practical source of tin. Many tin minerals are known, but none except this simple oxide of tin occurs in sufficient quantity to be an ore. Most of the others are so rare that they wind up in the collector's hands rather than in the smelter. Cassiterite is found in many lands,—even, to be sure, in the United States. But of the several mines that have been developed in this country, none has produced enough ore to repay the cost or to be considered capable of supplying the smallest fraction of the nation's needs.

Cassiterite is found in veins and is also recovered by washing placer deposits of gravel. Originally, of course, most metal ores are deposited in veins. The placer deposits are formed when rock-weathering and crumbling take the place of man's ball mills and crushers. Running streams sort out the heavy ores from the lightweight impurities in the same way that jigs and Wilfley tables do. But Nature takes more time than man and works for nothing, day and night, year in, year out. From Nature's concentrates thus laid down, man gets valuable treasures which once were so scattered in the rocks that he could never have recovered them economically. So it is with most of the tin ores. Only in a few places is cassiterite mined from veins, and many of these deposits are now exhausted or nearly so, only to be worked under the stress of wartime needs.

England once supplied the tin for


TIN Production
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● UNDER [illegible] TONS ANNUALLY
CONTROLLED BY ABCD POWERS
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JAPAN
CHINA
BURMA
THAILAND
INDO-CHINA
NETHERLANDS INDIES
MALAY STATES
AUSTRALIA
UNITED STATES
MEXICO
PERU
BOLIVIA
ARGENTINA
UNITED KINGDOM
GERMANY
PORTUGAL
ITALY
NIGERIA
FRENCH CAMEROONS
BELGIAN CONGO
UGANDA
TANGANYIKA
SOUTHWEST AFRICA
SOUTHERN RHODESIA
SWAZILAND
UNION OF SOUTH AFRICA

the Bronze Age and for the classical civilization of Rome. The mines of Cornwall are among the most important in the world, perhaps not for their actual production but for their contribution to the world's knowledge of vein mining. Cornish miners have gone to every land and carried their knowledge and their traditions to new nations. Cornish words are commonplace on the tongue of the miner and the engineer, though the tin mines of Cornwall have all but vanished. The cassiterites of Cornwall rank among the most prized specimens of their kind, and mineral collections of every land have been enriched by the showy products of these now legendary mines.

Typical waterworn gravels of cassiterite are brown, black, gray, or creamy and look little different from other pebbles. Only their extra weight makes them stand out from their fellows. Crystallized cassiterite specimens are comparatively uncommon. Cassiterite crystallizes in fine, sharp four-sided prisms, usually terminated by the sloping faces of a pyramid. Sometimes two crystals are intergrown at a definite angle. Such intergrowths are known as twins; and though many other minerals exhibit this formation, cassiterite twins are among the commoner ones in collections. The color is frequently black but may often be smoky, yellowish, or even reddish. Thin crystals are sometimes transparent. Gems have been cut from cassiterite, but such stones have little value and are of interest only to collectors.

With oxygen as the only major impurity in the usual tin ore, the recovery of the metal is not a long or difficult process. After the gravels of the vein ores of cassiterite have been concentrated, they are smelted in a furnace with the addition of carbon and some fluxes to separate out the other impurities. The almost pure tin sinks to the bottom, and after a little further treatment to separate out such things as iron, arsenic and antimony, is poured into forms.

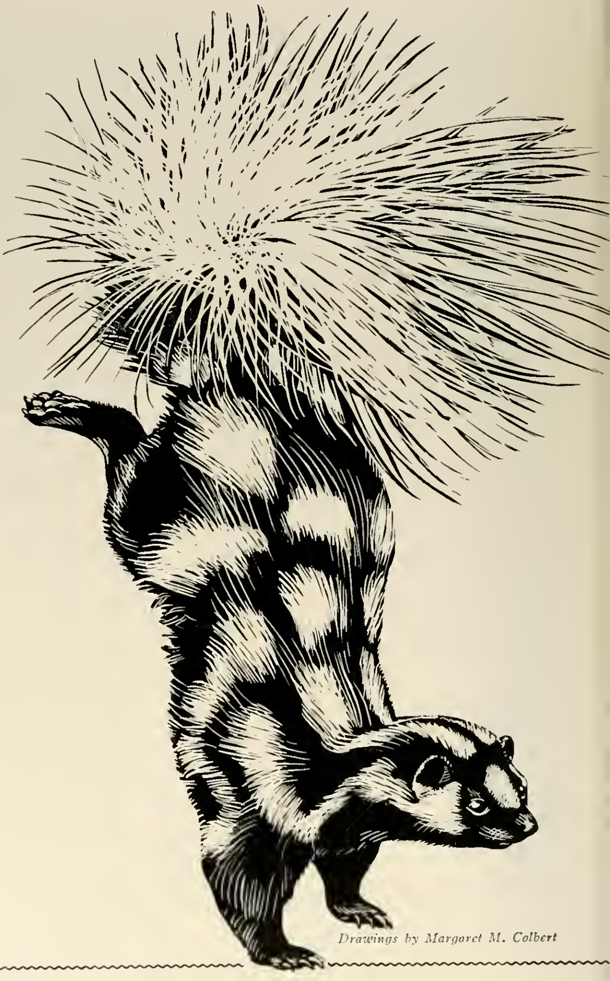
Today, most of our tin comes from Burma, Malaya, and the Netherlands East Indies — the Oriental tin belt. The production is almost entirely from stream gravels, though in one place it is dredged from the ocean floor. Only about one-fifth comes from the vein mines of Bolivia, though a recent report of the U. S. Bureau of Mines states that the Bolivian mines probably could supply about half of our needs. These mines are of interest to the collector because they yield beautifully crystallized specimens, associated with many other uncommon minerals.

As the placers become exhausted, we can look forward to the development of more vein mines, higher prices, and more showy specimens for our museums. American tin prospects do not look very bright. Workable tin deposits may possibly be discovered in this country, but there is practically no chance of their filling our total needs. For the present the best solution of the problem is to try to create an enormous stock pile, sufficient to fill a year's demand. Then if our sources are cut off, we will be able to continue in a normal fashion for a time while substitutes and reclamation methods are perfected. Our tin future, so to speak, is far from golden.

DON'T SKIN YOUR SKUNK

He may be a big help around the garden, and if you befriend him he will make a delightful and unobtrusive pet

By M. R. Bogert and C. M. Bogert


Drawings by Margaret M. Colbert

"Skin your own skunk" was a proverb of the pioneers. As a proverb it is good. As advice it's bad. Don't skin your skunk! If you have one inhabiting your yard, try to get a good look at him. He may be aiding you by eating snails or insects, and he's not going to spray you unless you provoke him by actual attack. At least we believe this to be so from our experiences with the diminutive spotted skunks in California.

A considerable population of these little animals inhabited the campus of the University of California at Los Angeles, although no one was aware of their presence until they began to fall into the concrete window casings of basement windows and were unable to climb out. Usually they were cautiously removed and liberated. But one morning in early spring a call from the watchman informed the Department of Zoology that a skunk had invaded the Chemistry Building, obviously not in need of instruction, and would someone please remove it—immediately!

The little animal was a female San Diegan spotted skunk (*Spilogale gracilis microrhina*), and was captured with little more than a very mild demonstration of her abilities. Not until later was the probable reason for her exploration of these premises revealed. Apparently she had been looking for a suitable place in which to raise a family, for the morning of the third day after her capture she gave birth to two hairless, blunt-nosed, helpless offspring.

One of them failed to survive, but the other was destined to outstrip his mother in size. At birth, in spite of the lack of hair, the pattern of the adult al-

THE SPOTTED SKUNK is perhaps the only animal that can stand on his hands without previous training. He will do it for a dog but not for a man. In this position he stamps the ground with his front feet, advancing several inches and retreating ready was apparent, with black pigment in the skin except for pink areas where the white markings were to appear. The mother quickly overcame her initial shyness, although she never lost all of her timidity. She nursed the single remaining baby until not long after its eyes were opened. This required more than a month, and meanwhile the hair had grown rapidly. At two months the young skunk was quite active; and by the end of three months he was essentially full grown, although the excessively long hair on his tail had not reached its maximum length.

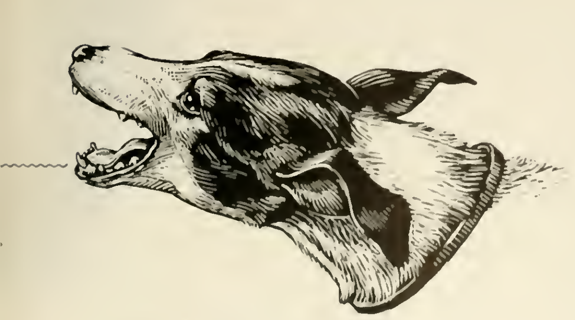
As soon as he was weaned he began to eat a variety of things that were offered to him, including fruit, insects, and dried milk. Canned dog food soon was consumed in enormous quantities. When the little skunk was hardly the size of a rat he would devour the better part of a twelve-ounce can of it in a day if given nothing else.

Playful

The youngster's behavior was not unlike that of a kitten,—if anything, he was more playful. He carried a crab apple about by the stem and dropped it from various elevated objects in the cage; he rolled it around and chased it until the stem had broken from the apple. Then, using his nose as a sort of billiard cue, he butted the remaining sphere about in a most amusing fashion. Since the bottom of the cage sloped to a center drainage hole, the apple invariably ended in the sump, where it chanced to fit securely enough to make it impossible for the skunk to remove it without spinning it around rapidly with his forepaws.

Before his eyes had opened, if he were separated from his mother, he would emit high-pitched, bat-like noises; but by the time he was two months old these noises had developed into a sharp bark that was used definitely as a gesture of intimidation. His mother never barked, although she uttered a sharp squeak when something surprised her.

She could be handled, and never attempted to bite. But the youngster, perhaps because he was a male, inherited little of her gentle manner. He soon made it known that part of the cage belonged to him, a part that he was willing to defend with teeth and claws. His sharp, metallic barks were usually sufficient to warn his mother. He never threatened her with his rear offensive, despite the fact that it was well developed at a tender age—a fact which was verified under unfortunate circumstances and eventually necessitated removal of the glands.



While skunks technically are carnivores, their habits in captivity disclosed an astonishing catholicity in diet. If the skunks were hungry they would eat any fruit or vegetable, and for an entire month they subsisted without ill effects on a diet of fresh figs and avocados. Eggs they took piecemeal, shells and all, although they usually transported them without breakage to the sanctum of a box before they ate them. Our pets never refused any insect we offered them, but they subjected hairy caterpillars to a special treatment before taking them into the mouth. With astonishing dexterity the skunks rolled the caterpillars in the earth on the floor of the cage, until they had removed nearly all of the potentially irritating spines, without once puncturing the caterpillar's delicate skin. Large hairy tarantulas of the common California species were similarly treated, and did not have an opportunity to use their fang-like "pincers," which might conceivably have discouraged such rough handling.

Frustrated by an onion

The method used in removing hair from tarantulas and caterpillars was similarly employed in ludicrous attempts to remove odors from other foods. When the skunks were offered a strong-smelling white onion about the size of a golf ball, the smaller skunk immediately seized it and carried it to one corner of the cage where he spun it beneath his forefeet, rubbing it vigorously into the earth while he held his nose upward and closed his eyes. But it was to no avail. After repeated attempts, followed by hasty examinations after each, he abandoned the onion. For no apparent reason, the skunks treated snails in the same way, but devoured them after a briefer processing, crunching the shells with apparent gusto.

Fresh meat was not often available, but from time to time a gardener would kill a pocket gopher, and this inevitably led to a fight between the two skunks. Other foods they could share on occasion, but a fresh gopher was something that each sought to keep from the other. With a skunk tugging at each end, the usual result was a successful, if messy, division of the rodent. Each skunk sought a far end of the cage for unmolested enjoyment of the delicacy. Live lizards were taken too, but not with any particular relish. The skunks killed them immediately after capture with quick bites that decapitated the hapless reptiles.

For some time these skunks had their scent glands, and for a while there were no unfortunate incidents. Spotted skunks seem loath to use their one effective means of defense, and they possess a repertoire of tricks calculated to discourage the enemy before taking recourse to it. Like their striped cousins they would stamp their front feet and then swing their tail end toward the enemy, at the same time turning their heads to peer in his direction as though taking aim. If this proved to be insufficient warning they finally resorted to a stunt that may be unique among mammals.

Handstand

Our skunks would stage this odd performance for a dog but not for a man. Apparently without any preliminary practice and in a manner showing remarkable skill and balance, they would throw their hind legs up into the air, extending them stiffly from the hips, and *walk on their hands!* In this position they continued to stamp on the ground with their front feet, as they advanced several inches and then retreated. This was always the final gesture, and never was it performed when people alone were present—such behavior was reserved for the reception of dogs. Doubtless in the field it is used to intimidate other animals. As a matter of fact, this behavior was never observed until the perineal glands had been removed. But this was no doubt because we had considered it prudent to keep dogs away from the skunks, for skunks in possession of their full powers have been observed to perform this curious feat.

The glands are essentially two syringes, with nozzles that may be thrust out through the sides of the anal opening. When the skunk goes into action, the liquid stored and secreted in these syringes is sprayed a distance of a few feet by the contraction of muscles surrounding them. One or both of the glands may be used, and if the first shot is not enough to put the enemy to flight, a few more are available. The glands are breech-loading repeaters, so to speak, and their effectiveness lies not only in their power to stifle the enemy but to cause temporary blindness or inflammation of the nasal passages if fired at close range.

The young skunk raised in captivity was accustomed to being handled from an early age, and it is not certain just when his scent glands reached functional maturity. Probably they were ready for use at an age of six weeks. After he was about two months old neither of us handled him for a period of about three weeks. During this time he grew rapidly, and when handled again he showed some resentment and an ability that necessitated removal of the glands. When liberated in the hall of the Biology Building he took flight—something he had never done before. Upon being halted abruptly by one of us, he perhaps construed the act as an attack. A jet of nearly colorless but whitish liquid was expelled from the nozzle of one gland, and when it struck the arm of his captor it produced a cooling sensation, not unlike a drop of ether. Soon the liquid had assumed a gaseous state and pervaded the building. Doors slammed, transoms went up, and one professor, not with complete naïveté we suspect, even called an assistant on the 'phone to complain of that pipe he'd been smoking! And there were other complaints, fortunately not expressed with the effluvium that emphasized the skunk's resentment, but emphatic nevertheless.

The odoriferous ingredient in the musk has been analyzed by chemists and found to be mercaptan, a substance analogous to the alcohols and therefore one that volatilizes rapidly. Removal of the glands is one effective way of spiking the skunk's guns, and it involves a simple operation on the adults. The two glands are each about the size and shape of a large olive and are located just under the skin between the hind legs. From very young skunks a skillful operator can remove the lining of the glands painlessly by thrusting a straightened fishhook through the nozzle and hooking the barb in the lining at the back of the gland.* If carefully done, the lining may then be withdrawn through the orifice with the hook, and since it contains all the secreting cells only the muscular portion of the gland remains, and the skunk becomes a safe pet. The loss in no way impairs the animal's normal activities, and while the skunk may stamp his feet, the threat is an empty one.

Nocturnal

As pets, skunks have some minor disadvantages, one of which is that they are generally most active at night. A revolving drum such as that sold for chipmunks was provided for the two skunks while they were kept in a cage. The younger skunk must have "traveled" miles every night, but he also sought such exercise sometimes during the day. After a run in the drum he would climb out and pause to look around with what was anthropomorphically interpreted as an expression of amazement that he had "gotten nowhere."

Despite their noctural proclivities skunks make better pets than most other wild animals, chiefly because they have relatively little fear. Possession of such an effective weapon of defense has made them perhaps a little smug, a trifle oversure of themselves, —more than one skunk may have discovered with regret, which must have been brief, that an automobile or locomotive is not readily intimidated. Man is doubtless the skunk's worst enemy, particularly since the advent of the automobile. However, horned owls reeking with the unmistakable scent have been killed by collectors on numerous occasions, and it is a reasonable assumption that young skunks fall prey to those feathered predators, as well as to badgers, coyotes, and similar enemies.

Particularly in Arizona the smaller skunk is distinguished from his striped cousin by the name "hydrophobia skunk." This name seems to date from 1875 when several cases of skunk bite were reported in that state. Subsequent investigation indicated that deaths had resulted from ordinary rabies, evidently epidemic at the time. All mammals are subject to infection with rabies, and may in turn bite and infect others. Coyotes were infected in a recent epidemic in California, and a skunk, totally unused to fleeing, would certainly fall an easy victim to a rabid animal the size of a coyote. Some authorities have voiced the opinion that skunk bites may result in blood poisoning, since the skunk is a carrion feeder. Perhaps, but several people have been bitten by skunks without any serious result whatever. Aside from an occasional epidemic of rabies among skunk populations there is little to fear from them, although the remarkable variety of food they will consume sometimes causes them to make nuisances of themselves.

Skunks have been known to raid beehives, not for the honey but for the bees. From time to time they may raid a poultry house, or rob a bird's nest, but by and large their diet in a natural state is believed to

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*As described by Vernon Bailey in "Deodorizing Skunks," *Journal of Mammalogy* XVIII (1937), p. 481.

Little more than a handful. Even the adult spotted skunk is a gentle animal and will not use its "double-barreled gas attack" without provocation. The two scent glands are visible between the hind legs

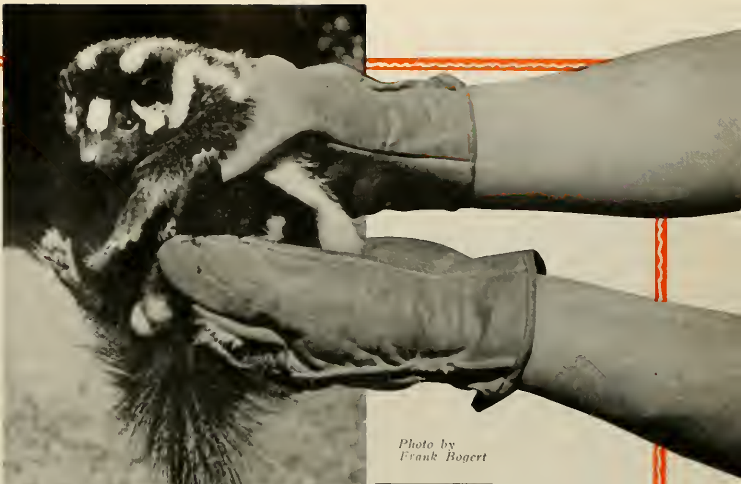
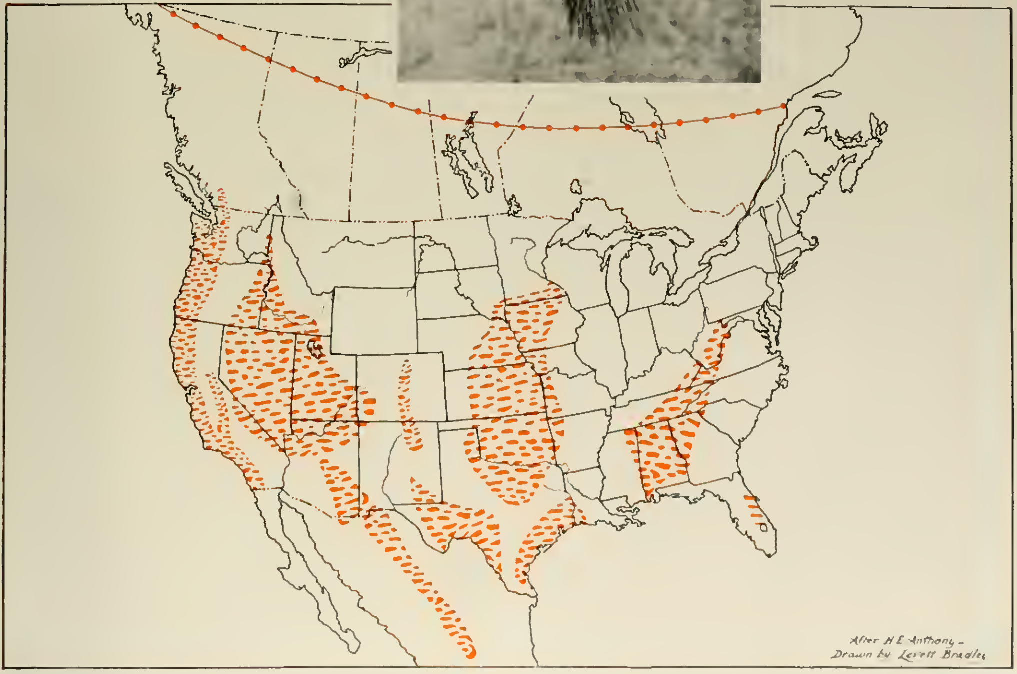


Photo by Frank Bogert

(Below) **The stippled areas** show where you may encounter the Spotted Skunk, from sea level to mountain slopes and in chaparral or timber. Our common Striped Skunk inhabits most of North America, roughly as far north as the dotted line, but seems loath to stray from permanent fresh water. The range of the "Hog-Nosed" skunk is not shown, as it barely reaches the United States along the Mexican border



After H E Anthony – Drawn by Levett Bradley

consist largely of insects, snails, small rodents, and lizards, supplemented with berries and herbs. True, a skunk may occasionally tangle with a dog at the canine's insistence and to its owner's disgust, but on the whole the skunk is almost certainly a beneficial inhabitant when faults and virtues are balanced.

Skunk dislikes own smell

Certain it is that skunks normally shun attack and use their defense weapons only when their warnings are not heeded. Possibly their conspicuous pattern has evolved as an advertisement of their potentialities, and the handstand of the spotted skunk may be interpreted as further flaunting of its Don't-Tread-On-Me banner. It is not altruism, of course. It is self-preservation, and observations indicate that mercaptan is just as obnoxious to a skunk as it is to any other animal.

A skunk that has not been attacked is as lacking in objectionable odor as any other animal. Skunks belong to the weasel family, known on every continent except Australia, and if you have ever been close to a frightened weasel you may have had an inkling of the relationship. The odor of a weasel, to our way of thinking, is far more disagreeable than that of the skunk, despite the fact that it is not sprayed out with much efficiency. Though only the skunk has evolved a first-class rear guard defense and gained a reputation, each branch of the weasel family is similarly equipped. There are minks and martins, the otters (even a sea otter), and the wolverines, not to mention the badgers and the weasels themselves, who have entered social circles under the names of sable and ermine. There have been attempts to improve the social rating of the skunks by application of the name "Alaska sable," but this was inspired largely by commercial interests. Most Americans prefer the Indian name, skunk. The term "polecat" is less commonly applied and rightfully belongs to a European ferret.

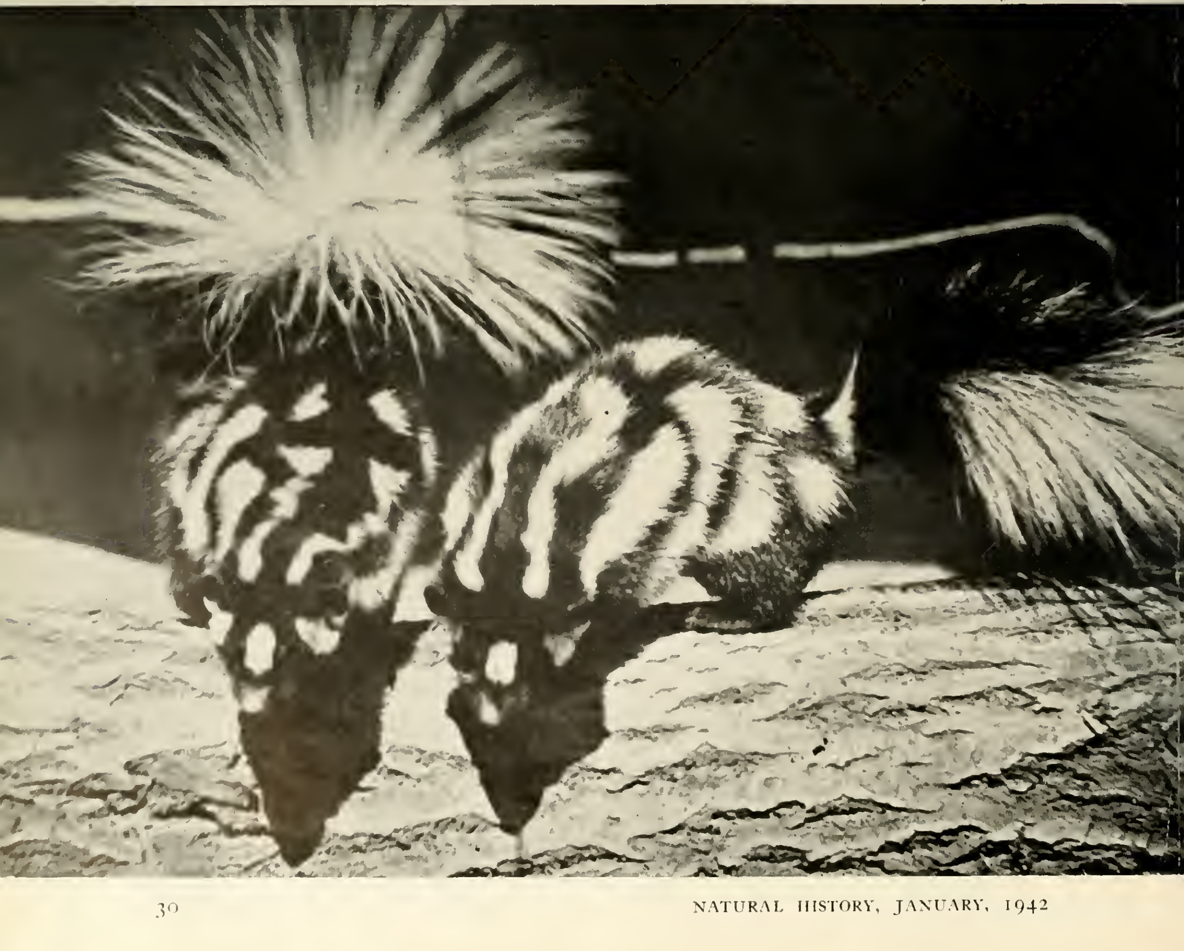
Of all the weasel family, no representatives in America are better known than the skunks. Perhaps this is because their presence is sometimes revealed without their being seen, and furthermore because they have not fled from the cities encroaching their habitats. Probably skunks are to be found in the suburbs of most American cities. Within the last year we have seen them within five miles of Manhattan,—although more commonly their presence is not disclosed until some dog with a gap in his education makes the discovery, and then the whole neighborhood knows. On the Los Angeles campus the spotted skunks must have been successful in avoiding dogs, because hardly anyone except the watchmen ever saw them.

The skunk's one effective means of defense is deservedly well known, and from the skunk's point, well it may be. His reputation may be bad, but when a skunk carries a disagreeable odor it's only because an enemy has persisted in ignoring his warnings. By preference he is a pacifist, but if provocation demands he is a well-armed exponent of the gas attack.

If a skunk happens to inhabit your premises he may be an economic asset. Don't skin him—but keep your dog away from him.

Mother and son: two spotted skunks which became faculty pets in the University of California at Los Angeles. The mother "invaded" the Chemistry Building and three days later gave birth in captivity. Her son would eat most of a twelve-ounce can of dog food in a day when scarcely as big as a rat

Photo by Frank Bogert



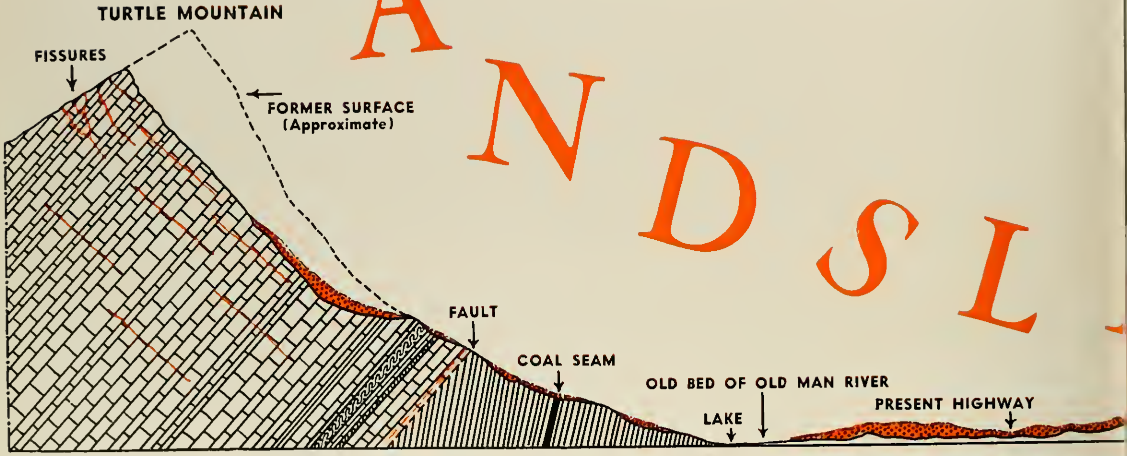
Photos by Frank Bogert

THE PETS never refused any insect offered them. They subjected hairy caterpillars and tarantulas to a special treatment before eating them, rolling them adeptly in the earth to remove the spines. A strong-smelling onion proved too much for the champions of scent. After subjecting the onion to the same rubbing process, with nose held high, the effort to eliminate the smell was abandoned

(Above) PERKING UP FOR THE CAMERA: an interesting portrait of the friendly animal whose name has become an epithet. Only the furriers have attempted to improve the social rating of the skunk—through use of the name "Alaska sable"

HIS UPRAISED TAIL is the skunk's Don't-Tread-On-Me banner. With defensive apparatus pointed toward the enemy, he peers around to direct his aim. Skunks do not resort to their attack unless their warnings are disregarded. A skunk that has not been attacked is as free from objectionable odor as any other animal. He apparently dislikes his own smell, too

LANDSL


TURTLE MOUNTAIN
FISSURES
FORMER SURFACE (Approximate)
FAULT
COAL SEAM
OLD BED OF OLD MAN RIVER
LAKE
PRESENT HIGHWAY

After the Annual Report (1903), Department of Interior, Canada

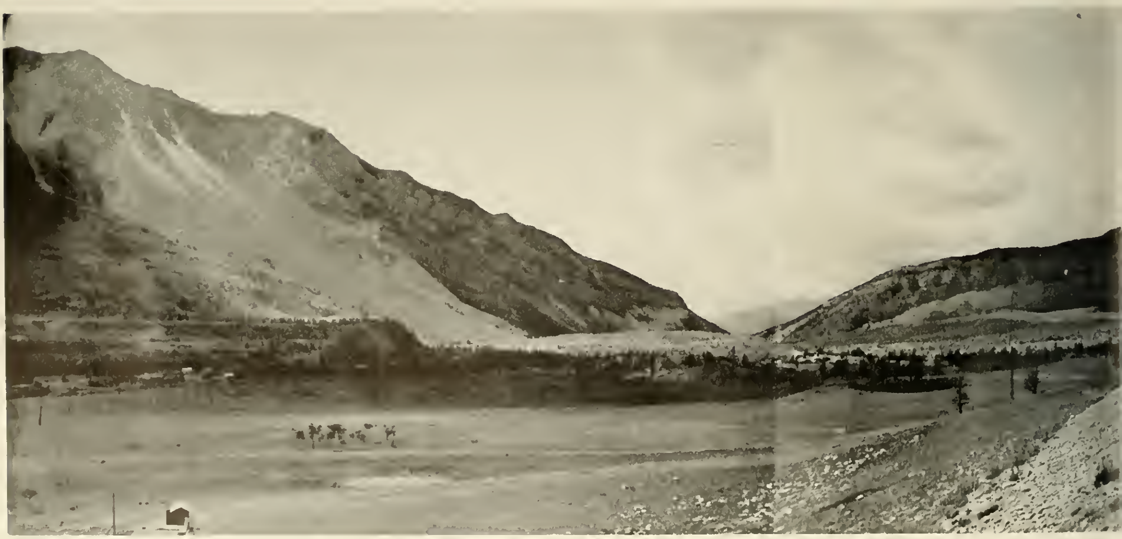


Photo by R. T. Bird

(*Above*) TURTLE MOUNTAIN, which "turned turtle." While the peaceful town at the foot slept, a mass of rock weighing 90 million tons—as much as 2000 of the world's heaviest battleships—rushed down upon it at express-train speed. The drawing above shows the joint cracks which weakened the mountain, and the mass of rock which fell. It is interesting to note that the most recent large landslide in the Western Hemisphere, which fell on the town of Huarás in Peru a few weeks ago, also happened early in the morning when the populace was asleep

The story of what happened early one morning when a town in the Canadian Rockies was caught in the path of one of the largest avalanches in history

By H. E. VOKES

Assistant Curator of Invertebrate Paleontology, The American Museum of Natural History

MOST of Nature's agents work slowly, so slowly that a thousand years in the shaping of the earth are like the ticking of the second hand on her clock. But she can also gather her forces over a long period and release them suddenly. Then the result is apt to be dismaying, as it was when the peaceful village of Frank, Alberta, was caught in the path of one of the largest landslides of history. While most of the village slept, a mass of rock weighing 90 million tons, as much as 2000 of the heaviest battleships afloat, crashed down upon it, covering a distance of two and one-half miles at an estimated speed of 90 miles per hour.

Late in the evening of April 28, 1903, Chapman, one of the nineteen men on the night shift of the Frank Coal Mine, paused before entering the tunnel. He looked around into the quiet valley of the Old Man River and up the steep slope to the crest of Turtle Mountain towering nearly 3000 feet directly above. The many vertical limestone cliffs seemed almost to overhang the mine entrance.

MacKenzie joined him and suggested that they go into the mine. It was too cold to stay outside. A few days before the weather had been unseasonably warm. In Calgary the temperature had risen to 74 degrees. The roaring waters of Old Man River in the valley below gave eloquent testimony that a great amount of snow had melted from the mountain. But tonight it was cold enough in all conscience. The thermometer might fall to zero before morning.

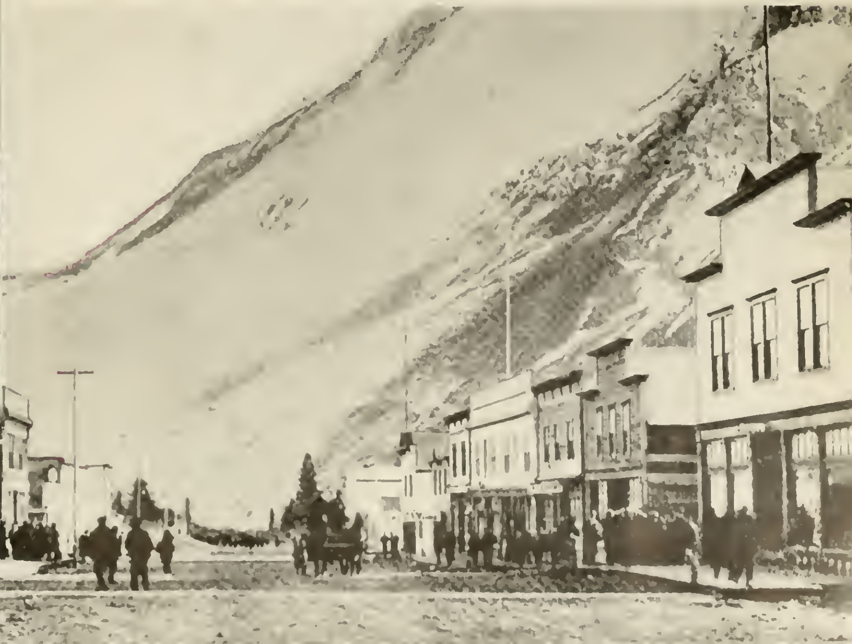
King Frost was preparing to take over the night shift in Turtle Mountain and on a scale out of all proportion to the human crew in the mine.

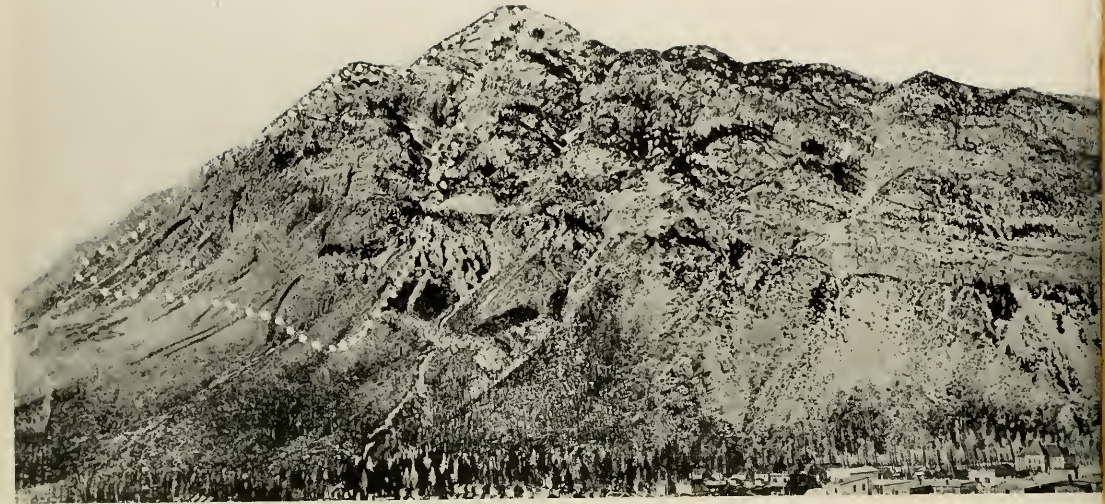
Chapman hesitated before going below,—for seven months there had been slight earth shocks in the mine, like the shuddering of a ship struck by a great wave. Deep in the tunnel there seemed to be a general squeeze in the ground. The timbers appeared to be under an excessive strain. Rockfalls in the mine chambers were increasingly frequent. The coal had begun "to mine itself." Some of the men had become worried and had gone on up to Blairmore to work.

Most of the lights in the town of Frank had died out and cold darkness was settling over the valley when Chapman entered the mine. The sec-

DE
OLD SURFACE

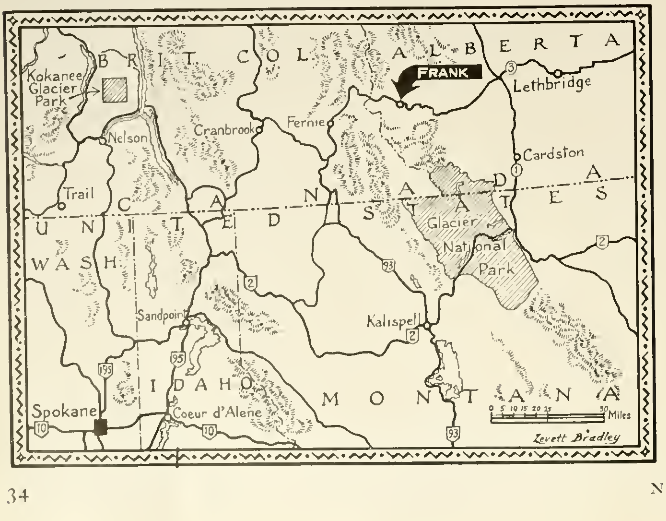
NINETEEN men were trapped in a coal mine beneath the avalanche and were believed lost. However, they dug their way out and are seen emerging just beyond the last house on the left in the remarkable photograph below. The wagon is carrying one of the men who was injured. The cloud of dust at the top is caused by falling rock





(*Above*) THE MOUNTAIN that fell on a town. The dotted line indicates the portion which fell—a mass half a mile wide and 400 to 500 feet thick in the center

LYING JUST NORTH of Glacier National Park on one of the main east-west routes through the Rockies of Canada, the scene of the great avalanche at Frank, Alberta, is easily visited by the tourist


BRIT. COL.
ALBERTA
FRANK
Lethbridge
Kokanee Glacier Park
Nelson
Cranbrook
Fernie
Cardston
Trail
CANADA
UNITED STATES
WASH.
IDAHO
MONTANA
Glacier National Park
Sandpoint
Kalispell
Spokane
Coeur d'Alene
3
1
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93
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195
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0 5 10 15 20 25 50 Miles
Levett Bradley

tion where the night crew were working on the 28th was a chamber where the roof was no more than 300 feet below the surface.

At four o'clock in the morning an engineer backed his freight engine up to the tipple at the mouth of the mine for a load of coal. The load that Turtle Mountain had in readiness for him was not a few cars of coal but a mass of limestone a half a mile square and 400 or 500 feet thick in the center. The engineer was startled by a sharp noise on the mountain. Instinctively he immediately threw his throttle to full speed ahead. In that instant he saw the whole side of the mountain tear loose with a roar like steam escaping under high pressure.

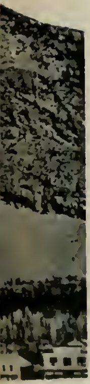
His train ran clear, but looking back he was horrified to see the men who were working at the entrance of the mine overtaken and buried by the slide. The avalanche roared down into the valley, wiping out the southwestern half of the town. So fast was its rush that, broken into innumerable fragments, the mass plowed through the bed of Old Man River carrying both water and river bottom with it and hurled itself up the opposite side of the valley to a height of 400 feet.

Down in the town, Mr. McLean, who kept a boardinghouse, happened to be up. He heard the noise and rushed to the door in time to see the slide shoot past him only a few feet away. The avalanche was so instantaneous that he thought that an eruption had blown out the base of the mountain directly in front of him.

A Mr. Warrington, who was sleeping in one of the cottages destroyed, was awakened by a noise which he thought to be caused by hail. Realizing that it might be something more serious, he jumped from bed. The house began to shake, and the next thing he knew he was 40 feet from where the house had stood, his bed

←

BEFORE



AFTER

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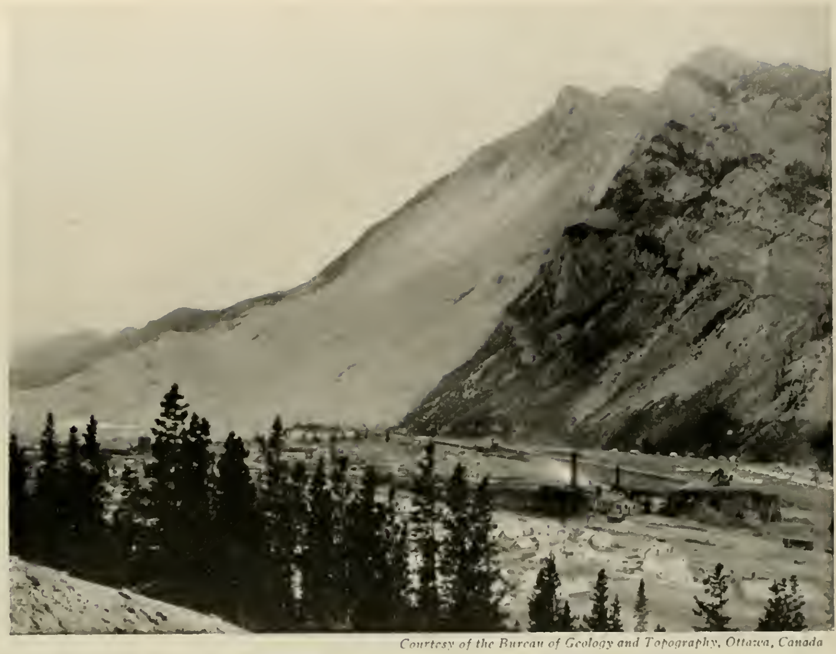


Courtesy of the Bureau of Geology and Topography, Ottawa, Canada

(*Above*) A RECENT photograph of the scene. The first noise of the avalanche sounded like a hailstorm. Then the full tumult split the air in a gigantic roar. A few persons actually witnessed the catastrophe. A boardinghouse keeper saw the slide shoot past him only a few feet away, and the engineer of a coal train ran his locomotive out of the path just in time

Photos by the author

THE MODERN ROAD crosses the devastated area, as shown at left and above. The rock looks so freshly broken that one can hardly believe the disaster occurred almost 39 years ago—especially when one sees rocks occasionally fall from the face of the mountain above some 20 feet farther on. His thigh was broken and he was otherwise injured, but he lived as one of the few persons ever to have survived actual contact with a giant avalanche.

The people of the remaining part of the town rallied at once to the rescue. But from the entire western section, where fully 70 persons had been living, there were less than half a dozen survivors.

What of the men in the mine—Chapman, MacKenzie, Chestnut, Morris—nineteen in all? Where the tipple had stood there was now a mass of broken rock at least 50 feet thick. Poor fellows, they had either been smashed in their chamber beneath the millions of tons of rock or were hopelessly trapped beneath it. It seemed impossible even to recover their bodies in the rock wilderness.

Three hundred feet below the surface, the first signs the miners had had that anything was wrong was a great blast of air through their tunnel. It blew all the trap and safety doors open and threw men and horses off their feet. The mouth of the tunnel was at once blocked by broken rock.

Deeper in the mine, coal suddenly started to break loose and shower down the manways. The men working near by became frightened and started to escape down the ladder. As Chapman raced down he heard a scream of agony and looked up to see MacKenzie caught in a cross-passage which was partly sealed by crushed and fallen rock. Though lacking tools, Chapman sprang into the danger zone and with his bare hands tore the rocks from MacKenzie and carried him to the tunnel below. All the way down he was battered by falling coal but was saved from serious injury by his miner's helmet.

The tunnel entrance was completely blocked, and the lower tunnel was full of sulphurous water. Chestnut volunteered to try to escape through one of the airways, but soon returned with the news that bad gas pockets were forming there—the airways had also been closed by the slide. They tried to estimate from this how thick the avalanche must be above their heads. Should they attempt to dig out through the debris over the tunnel, or try to drive a shaft to the surface farther back in the mine where the surface slope was deeper and the avalanche probably less thick?

After some discussion it was decided to attempt the latter. But the tools were at the other end of the tunnel, a mile from the entrance. Volunteers agreed to attempt the hazardous passage back through the tunnel, braving the falling rocks, to secure these tools and some necessary timbers. Four thousand feet from the entrance, the upper wall of a large chamber had been crushed in almost eighteen feet, and they had difficulty getting around the obstruction to the tools. It was almost seven in the morning when they returned, and the way the rocks had been settling convinced them it would not be possible to go back for more equipment.

All morning and into the afternoon the men worked in shifts driving the shaft towards the surface and timbering it with logs removed from the tunnel. Gas began to collect in the upraise, but driven on by desperation they persisted until about five in the afternoon, when they suddenly broke through—to be greeted with a shower of rocks. Luckily all but one of the men escaped this new danger, and he was not seriously injured. The rock fragments fell for only a few minutes, and a cautious investigation showed that the way was open to the surface. They came out almost on Dominion Street, the main thoroughfare of Frank.

Once above ground, Chapman looked up at the mountain. Its eastern face was entirely different from when he last saw it, and the valley he had known so well was now a chaos of rock fragments. He did not realize it, but he was looking at the largest known rockslide that had occurred on this continent and one of the largest that had occurred in historical time. It covered over one square mile and had an average depth of about 65 feet.

What caused this great mass to break loose from the mountain? And why had it fallen at this time? The answer to the first question can be found in the structure of the mountain itself. Turtle Mountain is composed of a great thickness of Paleozoic limestone, thrust up over a series of younger, relatively soft Cretaceous sandstone and shales, with some rather thick seams of soft coal. The slope of the upper part of the mountain averages over 45 degrees, and in the part which broke away, it may even have reached 75 degrees. This great mass of limestone is cut by an extensive series of joint cracks, developed at right angles to the bedding. The cracks dip towards the valley at a much lower angle than does the slope of the mountain itself, forming great wedge-shaped blocks, which, if broken loose, will slide into the valley.

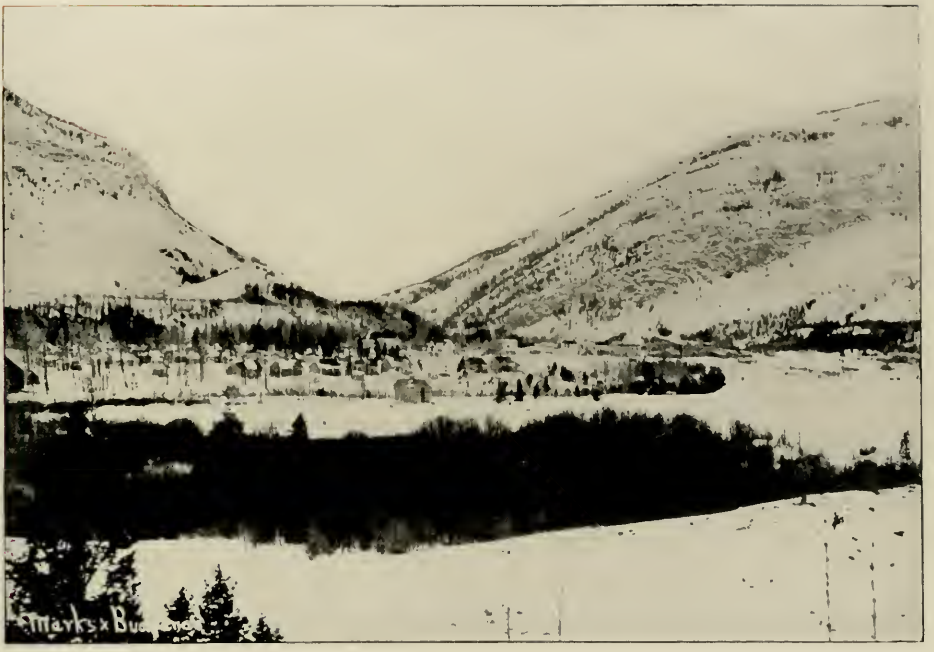
Several causes combined to precipitate the avalanche on April 29th, 1903. The mine was right at the foot of the mountain, and in the light of the rockfalls and earth shocks which the miners had been noticing for over a period of seven months, it seems certain that the soft Cretaceous sediments were settling and giving under the weight of the mass of the mountain. It is probable that the shocks were communicated to the limestone mass itself and served to break open the joints which weakened it.

But the unseasonable weather determined the hour at which the calamity occurred. The unusual warmth of the past few days caused extensive melting of the winter snows, and this melted water had penetrated the open joint cracks. Then on the 28th there was a sharp change to cold weather, and the thermometer fell to zero in Frank on the morning of the slide. The water in the joint cracks froze. As it froze it expanded, tearing loose the last supports which held the mass in place, freeing it to hurtle down into the valley as one great avalanche of destruction.

Easily reached, since it lies in Crowsnest Pass, which is one of the most traveled east-west routes through the Rocky Mountains of Canada, the Frank slide is one of the most remarkable geologic phenomena that the writer has seen. Some of the accompanying photographs, taken in 1939, show the slide as it appears today. The rocks look so freshly broken that it is hard to believe that this disaster occurred almost 39 years ago.

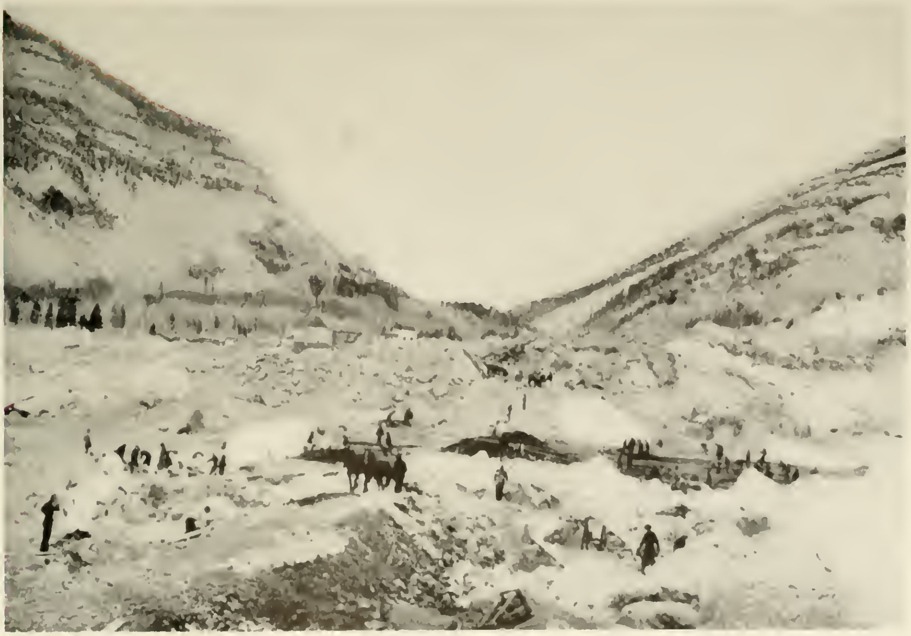
People still live in the town of Frank, though the structure and disposition of Turtle Mountain are the same as before. A geologic examination of the mountain in 1910 showed that new fissures were developing behind the steep slope. One cannot say it won't happen again. You drive across the chaos of broken rocks, and a feeling of apprehension comes over you. You glance warily up at the mountain. Sometimes when you look, a rock will fall from the cliff and come tumbling down. You look and you wonder whether Nature is spending her energies in her slow, normal way, or whether she is gathering them for another gigantic cataclysm.

BEFORE



TRANQUILLITY TURNED INTO CHAOS—two photographs taken from approximately the same spot. From the entire western section of the town, where fully 70 persons had been living, there were less than half a dozen survivors. An area of over one square mile was covered by the avalanche

AFTER

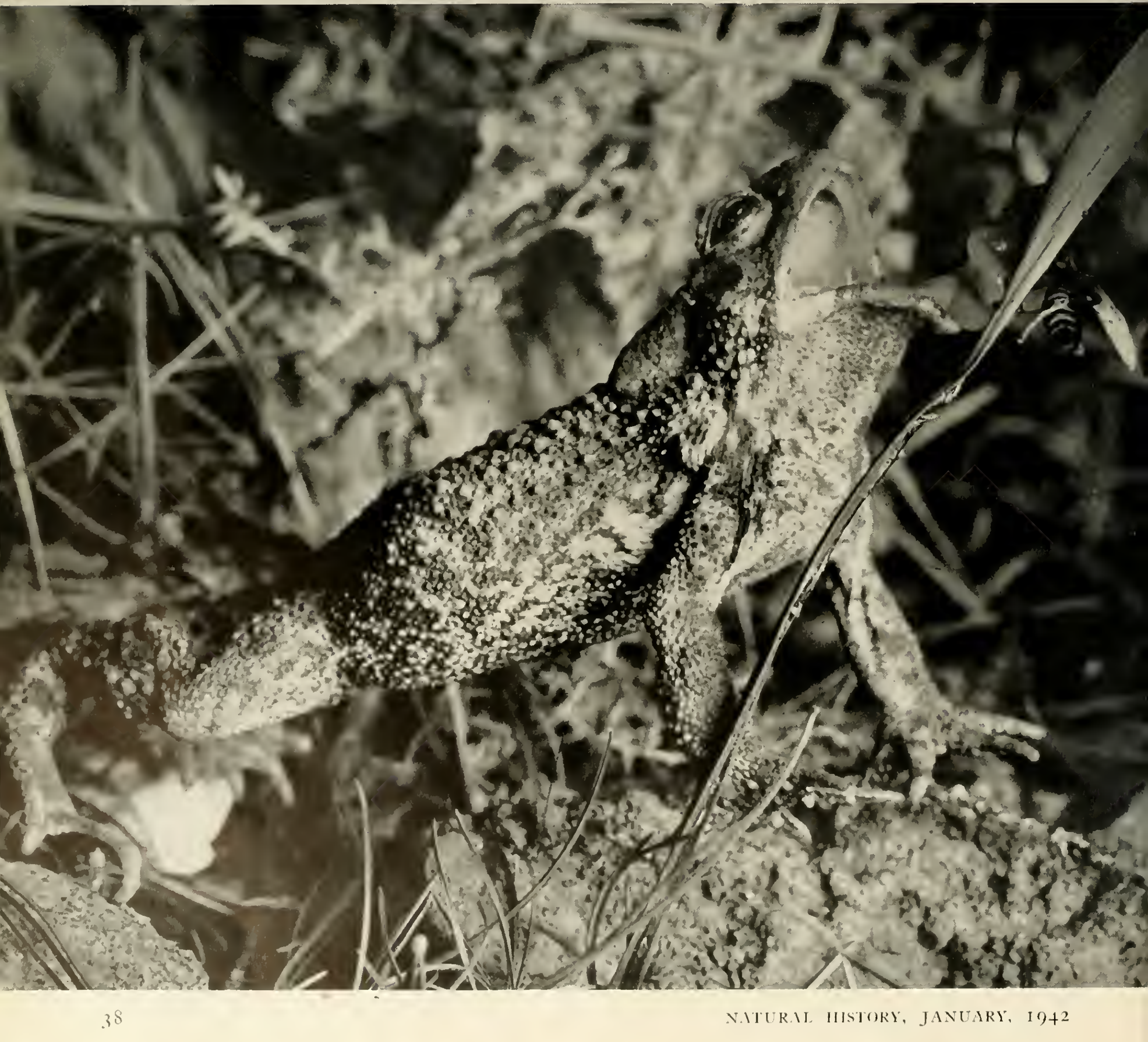


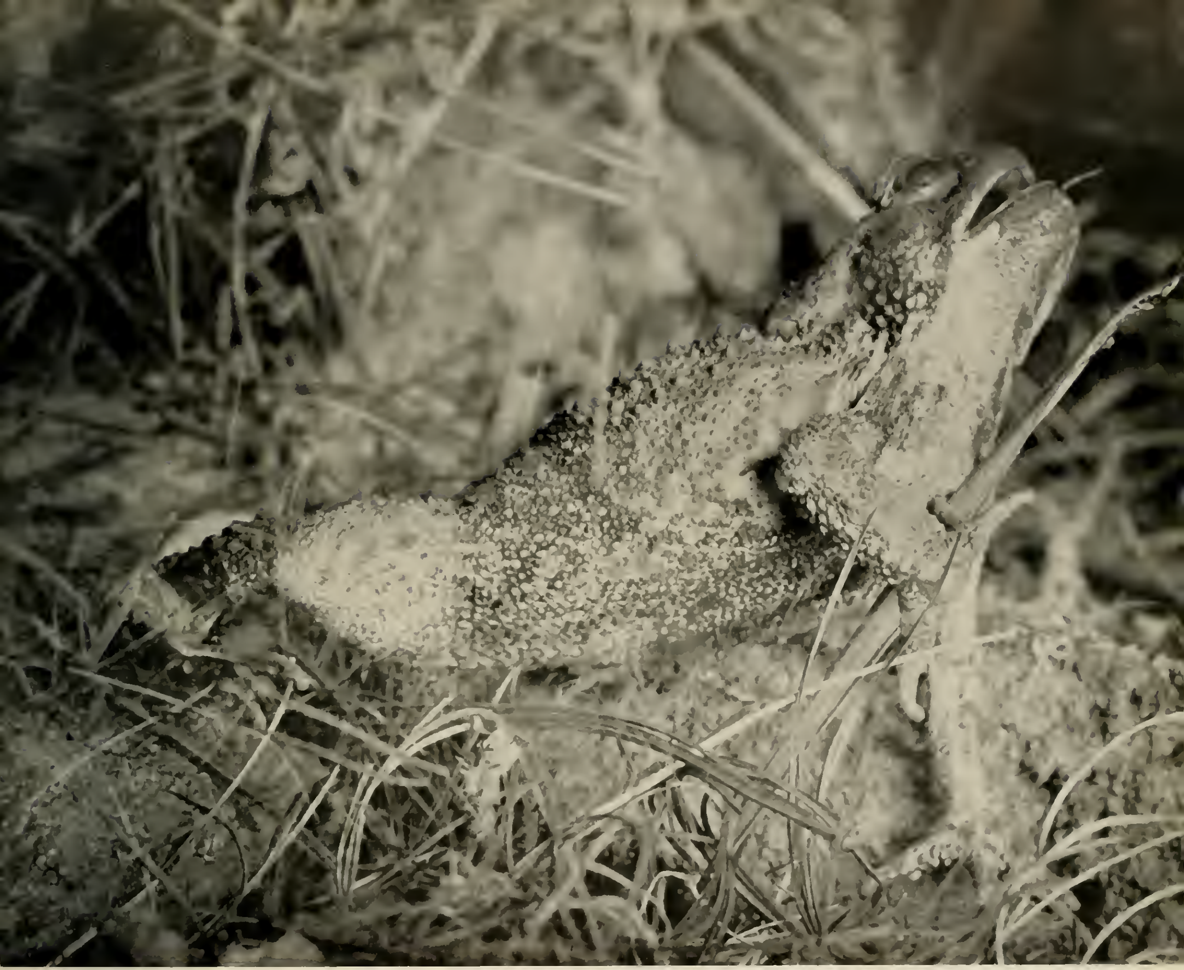
FAST FEEDER

The superspeed camera catches Mr. Toad making a "boarding-house reach": the first photographs showing a toad in the combined act of leaping and capturing its food with its tongue

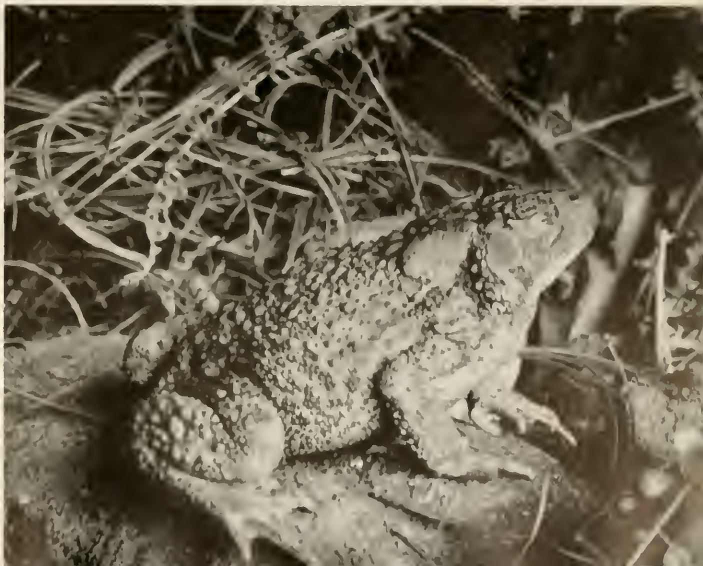
By HENRY B. KANE

1 MIDAIR in his leap toward the wasp, the toad darts out his sticky tongue. The tongue is hinged in front instead of at the back like ours





2 THE QUICK WASP is not quick enough to escape the lightning-like flick of the tongue, and the toad's mouth closes on the insect like a trap



3 FROM THE TOAD'S PAINED EXPRESSION it might be supposed that the wasp has fought back, but this probably would not bother the toad. Humans sometimes close their eyes when swallowing medicine; the toad always does

RESTLESS GIANT OF THE PHILIPPINES

Photo by C. Limpo

The Philippines' famous volcano in the 1938 eruption. The restless giant roars forth tremendous blasts of gray-black dust clouds, and the column rises into the upper atmosphere, where it is crowned by a diaphanous curtain of frozen white vapor. The dust may travel 50 miles

In its quiet moments Mayon Volcano is a thing of beauty. In eruption it provides a spectacle almost indescribably terrible and magnificent. Yet the natives till the fertile fields right to its threatening slopes

By HUGO MILLER*

WHEN Manila newspapers run the headline, "THE MAYON IS ERUPTING," the Filipinos take new thought of their famous volcano, a restless giant in which they may ordinarily have felt a sort of pride. Immediately Malacañan, the seat of government in Manila, makes its channeled inquiry to provincial officials. The Red Cross gets in touch with the situation. From their fields around the capital, army airplanes, both Philippine and United States, fly 200 miles south to the Bicol Peninsula on which Mayon is located. The planes of the commercial air line are booked up, and the Manila Railroad Company puts extra coaches on its southern line to take care of the civilian sight-seers who may wish to tear themselves away from the metropolis and risk beholding so awesome a spectacle. For Mayon Volcano does not frequently erupt itself into the headlines. Its last interval was ten years, and its latest outburst occurred in June, 1938.

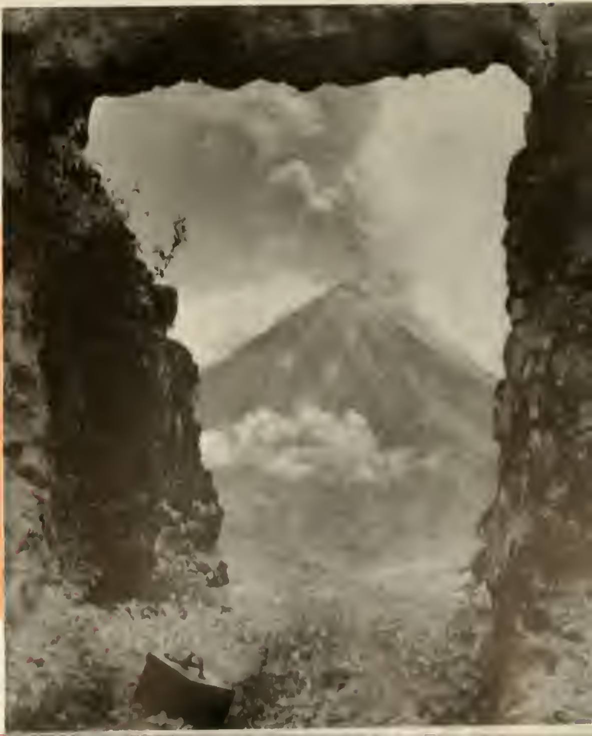
If you ever have the opportunity, don't fail to see Mayon Volcano, even if it is quiescent, for it is the most symmetrical mountain in the world, and its slopes are unblemished by any secondary cones.

Mayon Volcano stands apart. From the sea it rises in a perfect curve some 8000 feet above the waves that lap its base. From the shallow Bicol Valley, it slopes upward with equal symmetry out of a pattern of rice dikes. Its lowest slopes are green with spreading banana plants and plumed coconut trees, interspersed with open spaces where rice is cultivated. The middle slopes are deeply scarred with ravines that lift the eye upward through grass-covered ground to the barren and austere cone itself, silhouetted against the clear sky, or through soft, white clouds that gradually disappear into the blue. There is nothing soft about Mayon Volcano. It remains aloof and detached—a perfect picture of cataclysmic strength held in leash against the humans who dwell in towns and villages and work in the fields at its base. From its crater, a thin plume of vapor rises as a reminder that this is no dead shell but a living form that may break the leash when it so wills.

Even during its quiet moods, Mayon is a satisfying and worth-while sight. Now that the railroad has been completed, it is possible to leave the Paco Station in Manila at seven in the morning and be in Legaspi, the seaport at the base of Mayon Volcano, by nightfall. Buses make regular trips over the 40 miles of road around the base of the volcano, or automobiles may be hired for the trip. The nearest approach on the main road is about three miles from the top of the cone. On a side road, one can ride through virgin forests past a resthouse to an altitude of some 5000 feet, and it is from this place that ascents to the crater are made when the mountain is quiescent. Here a gully, bottomed by an ancient flow of hard lava, rises some 3000 feet straight up to the sulphur fumes that

(Below) THE CONE OF MAYON viewed through a window of the church that it destroyed

Photo by Signal Corps, Philippine Army



(Left) A SPANISH GRANDEE and a beautiful young woman recently come from Spain were on this historic spot when the church was buried under an avalanche of rock. She was in the church, he at the door watching her at her devotions. When the avalanche of incandescent rocks fell, the lady was buried, while the grandee, helpless to aid her, was spared. During this eruption in 1814, 1200 people in the municipality of Cagsaua lost their lives. The ashes of several hundred lie under the rocks in the nave of the church. *(Photo by Hugo Miller)*

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*The author wishes to acknowledge the help of the Reverend Father Miguel Selga, S. J., Director of the Philippine Weather Bureau and Vulcanologist, with whom he discussed the scientific and historic points contained in this article.

swirl out of the crater. The climb requires not only strong legs and arms but also an ability to slide and wiggle on both back and stomach. Sometimes strong winds force back the most expert climbers.

However, the resthouse side of the volcano is not the most spectacular during an eruption, for above the crater there is a semicircle of material from a previous eruption which usually prevents the ejected material from coming down these slopes. It is from the ocean side, and especially a place about five miles in a straight line from the top of the cone, that the best view can be had of an eruption. This vantage point is called "Kilometer Nine." To get the whole sweep of the volcano one must go by launch to San Miguel Island, twelve miles from the cone, from which point the mountain can be seen through green coconut palms, across the blue waters of the strait.

To those scientifically minded, I recommend an interview with the Reverend Father Miguel Selga, S. J., Director of the Philippine Weather Bureau, the vulcanologist who prods Mayon and finds answers to the what's and why's of its volcanism and who advises the authorities about moving the people on its upper slopes down to refugee camps. In Legaspi one can find people who have ascended to its top and know the volcano as a friend.

In the early stages of an eruption, Mayon Volcano is as periodic as "Old Faithful" in Yellowstone National Park. "When will the next eruption be?" you ask, on your way to Kilometer Nine.

"You will have time to make it," is the reply. "She is erupting every four hours, so the next show will be about noontime."

And then it comes

Mayon in eruption has none of the soft and sprightly beauty which rises and falls in white, hissing surges from the crater of Old Faithful. Mayon never loses the solid dignity of its perfection nor fails to express its power. In an eruption its grand complacency changes to magnificent awe-inspiring action. It roars itself into the stratosphere in tremendous blasts of gray-black dust that seem to cast over the land the shadow of the volcano's might. It snarls—not with the irritation of a caged tiger but rather with the boredom of a restless cat in its lair—a snarl at inaction, and perhaps a warning. Even in eruption, Mayon remains detached and superior.

Suddenly, from the crater, a small dust column emerges. Is this the scheduled paroxysm?

The gray column rises and plumes off with the wind. Higher and higher the column rises, its base forming a clean-cut cylinder over the cone. Then there is an outburst—as if the top of an immense iron teakettle had been blown off by steam escaping from violently boiling water—and, almost in a second, a great blast of gray-black dust rises a mile or more into the atmosphere. A roar comes down from the mountain. Above and outside the furious black surge, a volley of rocks can be discerned by the naked eye, as it is thrown into the clear. The outbursts come one after another, and the black dust column swirls and puffs higher and higher into the air. With each outburst there is a roar and a volley of stones, whose impact on the side of the volcano can be heard.

After the first blast, the base of the smoke column changes. Spurts of light gray dust seem to shoot from beneath it down the side of the cone, like rays in a star sapphire. But these soon develop into a confused mass of billowing black clouds, a mass that swirls halfway down the mountainside and at the same time rises to join the dust column above the crater.

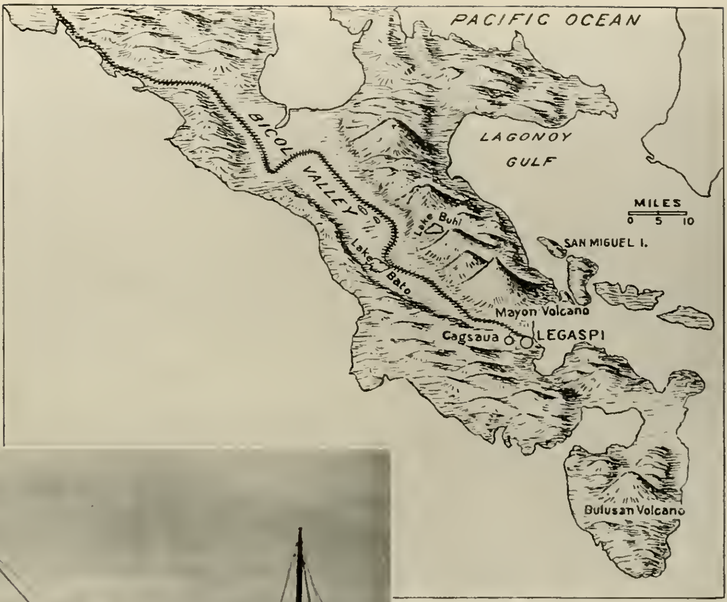
Soon the dust column penetrates the upper atmosphere, its top covered by a diaphanous kerchief of frozen white vapor. The sunlight reflected on the dust column varies the color effect. Sometimes it appears as black as coal, often gray as smoke from a factory chimney, and again it is a shimmering white beneath the dead-white kerchief that so sharply separates it from the blue of the sky.

In the meantime, the dust rising from the mountainside is carried out and away by the wind and begins to settle on the slopes. Gradually, as the paroxysms lose their force and frequency and finally cease, the column itself enlarges and slowly disappears, the dust floating away into the stratosphere and the atmosphere or descending to the earth. There are evidences of dust 50 miles from the cone of Mayon and, on the lee side, the dust gives a gray coating to vegetation even 25 miles away from the crater. It seems to dry up banana leaves and the foliage of other delicate plants, but otherwise no harm is done. In fact, the accumulation of dust in the soil has made the lower slopes of Mayon Volcano the fertile lands that they are.

After dark

Night turns on the lights of Mayon and makes it incandescent. In the dark a quiet outpouring of white-hot rocks can be clearly seen. From the crater, the headlong path of each is marked, like the fall of a meteor, by a head of reddish-white light and a constellation of sparks broken off as the rock bounces along. As the slope of the volcano flattens out, the progress of the rocks is slowed and they advance in jerks and spurts, pushed on by the force of the ejected material behind them which finally collects in great mounds.

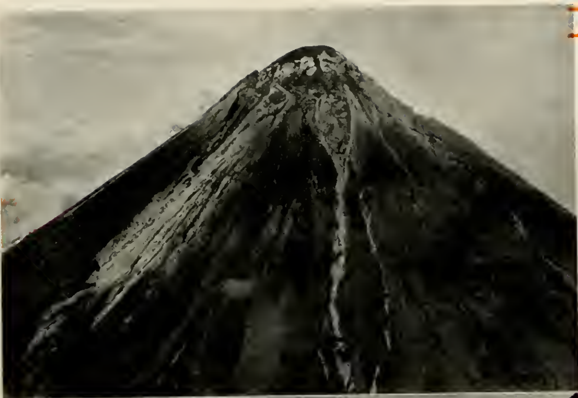
Hence, Mayon in silent eruption at night is aglow with rays of lambent reddish-white light, sparkling, MAYON is one of a row of six volcanic cones at the southern extremity of the island of Luzon, approximately 200 miles southeast of Manila. Four of the cones are "dead"; of the remaining two, Mayon is the more active


PACIFIC OCEAN
LAGONOY GULF
BICOL VALLEY
MILES
0 5 10
Lake Buhi
SAN MIGUEL I.
Lake Bato
Mayon Volcano
Cagsaua
LEGASPI
Bulusan Volcano

Photos by Hugo Miller

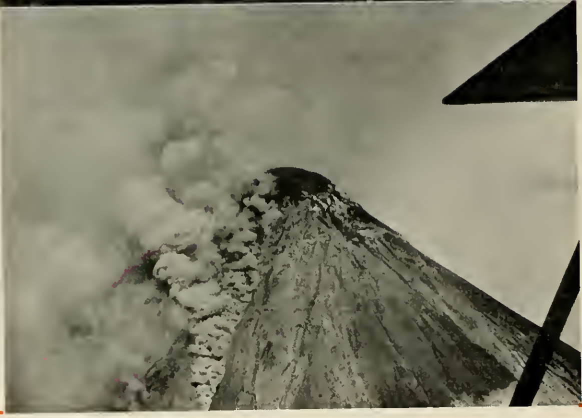
HERE IN A PORT under the shadow of Mayon, outrigger sailboats drop anchor with cargoes from the islands and coastal villages. It is in this region that the Japanese have attempted to establish one of their beach-heads

A LAKE IN A LAKE. In prehistoric times a volcano died, leaving a depression which filled with water to form Lake Taal, twelve miles across. Today the crater of Taal Volcano lies in the island shown at left, and in that crater is another lake. In this island crater, pools of colored water used to boil. Then in 1911 Taal erupted one night in a spectacular paroxysm and snuffed out over 1000 lives. Since then the water in the crater has been cold and quiet



Hot rocks rolling out of the crater produce the spurts of dust or gas visible on the left-hand flank of Mayon in this aerial photograph. From this side the crater is concealed by a semicircular wall left by a previous eruption. Note the gulleys down which the ejected incandescent rocks roll when the volcano goes into action

Air photos by Signal Corps, Philippine Army



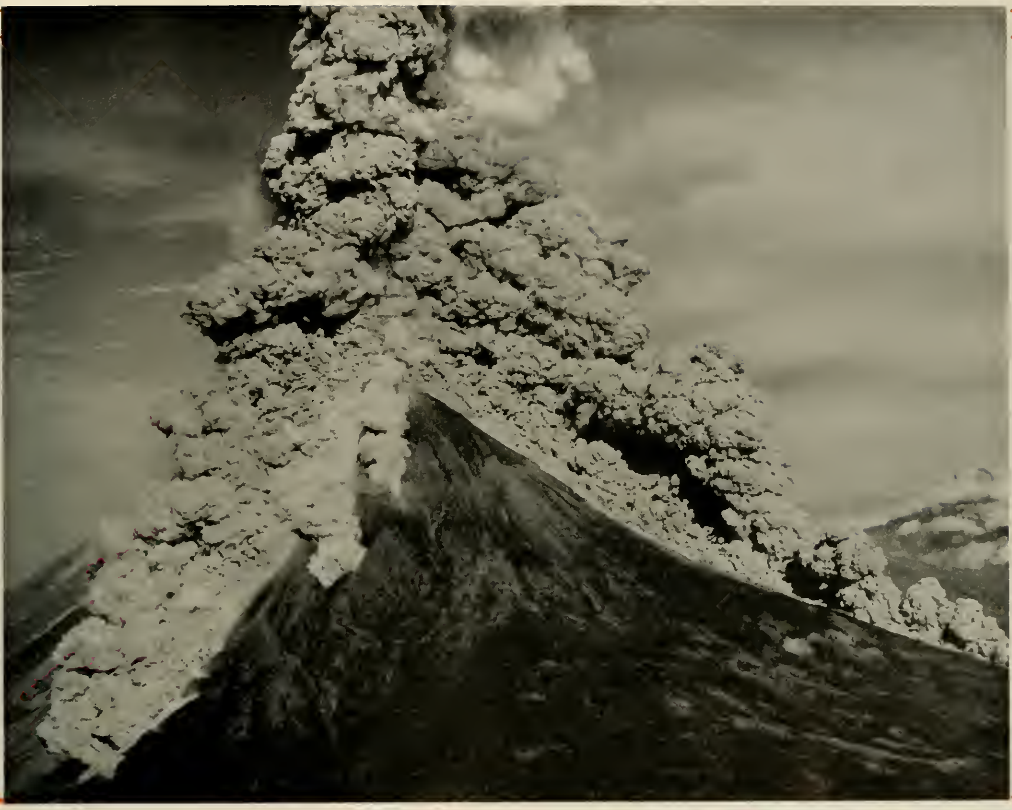
(Left) Mayon is now in "silent" eruption. White-hot rocks spill out of the crater and rush down the gulleys, emitting superheated steam and other gases

(Right) As the eruption becomes paroxysmal, great quantities of rock roll down Mayon's gulleys and disintegrate into great billows that rise in a confused mass to join the gaseous column over the crater

Air photo by United States Army Air Corps

In spite of Mayon's threat, work goes on in the shadow of the famous volcano. Here a peasant is cultivating his rice fields with a wooden harrow pulled by a water buffalo. In the distance, trash is being burned and rain clouds veil the slopes

Photo by Hugo Miller



The rich volcanic soil of the region, aided by heavy rainfall, yields the world's best rope fiber. A kind of banana plant called abacá is the source of the world-famous Manila rope. The native at left is stripping the fiber from the leafstalk. Four children who know Mayon Volcano as a near neighbor are shown below beside bundles of newly stripped abacá fiber hung out to dry. In the background can be seen the banana-like plant that yields these fibers

Photos by Hugo Miller

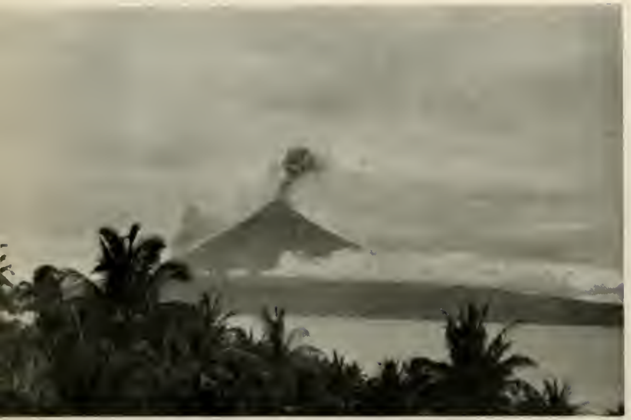
flickering, wavering, and gliding down the mountain to pools of phosphorescent luminousness. The glow is reflected and radiated from a thick cloud of water vapor and gases which rises from the distintegrating materials. The full moon, although it floods and penetrates the whole landscape, remains unnoticed, for its illumination seems to be concentrated in the streams of light on the mountain.

A shower of incandescent rocks

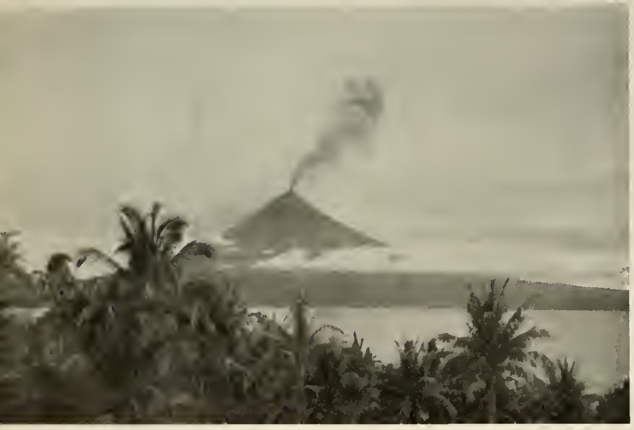
From the top of this shimmering radiance, one suddenly feels a glare. A vivid brightness rises from the crater. Then with a roar, hundreds of incandescent rocks spill out or flash up a mile or two and, curving, descend like falling stars upon the side of the cone. For a few moments, the mountaintop is a blaze of brightness. Now down the side of the mountain roll black billows behind tongues of light from incandescent rocks that spurt out ahead. Above the crater itself, an oval of brilliant luster pierces the pitch-blackness of the Stygian cloud, and from this resplendent jaw of darkness the incandescent rocks flare, fall, and disappear into the blackness below. It is as if the devil's munition dump had suddenly been touched off.

The impression of Mayon's gray magnificence in daylight and its radiant transplendency at night remain a vivid memory.

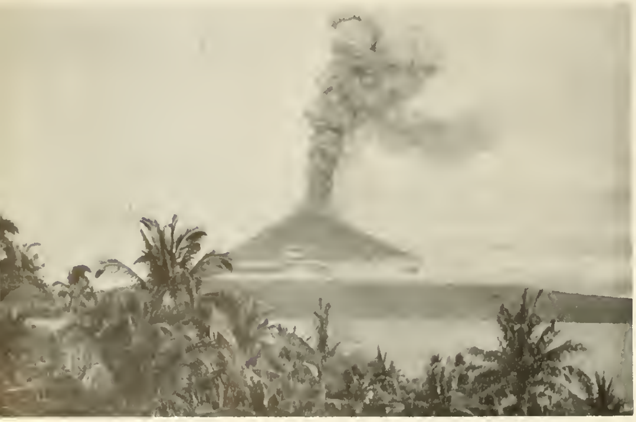
Apparently no burning gases flame out of the crater of Mayon. Its luminousness is entirely derived from incandescent material, just as light from an incandescent globe is produced without flame. The incandescent material is white-hot rock. Volcanic ejecta that are high in silica, as from Mount Pelée, Martinique, have comparatively high fusion points and solidify rapidly at the temperature of the atmosphere. In a siliceous lava flow, the outer crust solidifies rapidly; but under it the mass remains plastic and continues to advance, producing a sort of rolling and churning motion. Ultimately it hardens to form a slaggy lava known as "scoria." The material from Mayon Volcano contains about 50 per cent silica, and the solidifying point of the mass is comparatively high. As the top of the column of molten material reaches Mayon's crater, it is already a solid but nevertheless white-hot rock. The pressure of the gases within this solidified mass is much greater than the pressure of the atmosphere. For this reason, as the rocks come to the surface, they not only carry with them dust scraped off from the inside walls of the crater but they themselves are partly disintegrated into dust by the escaping gases. The latter fact explains the noiseless column of dust that rises out of the crater as the first sign of paroxysmal eruption. However, the disintegration is far from being complete. A solid cap forms over the crater and escaping gases accumulate under



IN THE EARLY STAGES of an eruption, Mayon is as periodic as Old Faithful. You may be told that she is erupting every four hours. Then suddenly a small dust cloud rises



YOU CORRECTLY SUSPECT that a paroxysm is beginning. Higher and higher the column rises, clear-cut and ominous above the layer of atmospheric clouds



(Left) Now the smoke-column thickens and towers higher. Bursts of gray gas glide down the slopes of the cone like the rays of a star sapphire

Photos by Hugo Miller

it, finally blowing off with a loud roar. The cap is then broken into dust and rocks, some of which are as large as a small house.

Whether they be thrown merely over the side of the crater or hurled a mile or two into the air, they all fall, finally, onto the side of the cone. There they gather in gullies that have been washed into the soft sides of the mountain by tropical rainstorms. As the rocks roll down these gullies, they continue to disintegrate through the force of the escaping gases and give off spurts of gray dust and billows of black dust clouds which, carried by the gases, rise to join the dust column over the crater. Mayon is thus nothing more or less than a slag heap, 8000 feet high, made of some lava flows but mostly of dust, sand, cinders, and rocks of all sizes, including ones that cooled before they could disintegrate. This is how vulcanologists explain the eruption of Mayon Volcano and its perfect cone. The nature of the gases imprisoned in the incandescent rock is not definitely known. But from the cloud of water vapor that rises from the ejected material, it is obvious that a great quantity of superheated steam is present.

The quiet life below

People who live in the shadow of a volcano are in general a phlegmatic lot, and so the day's work goes on whether Mayon be quiescent or in eruption.

The water buffalo must be guided as he pulls the plow and the harrow over the rice fields. The seed beds must be seeded, the young seedlings thrust into the mud that is confined by the rice dikes, and, when ripe, the rice must be harvested.

The volcanic sides of Mayon and the heavy rainfall of this region developed a kind of banana plant that is indigenous to the Philippines. Its native name is *abacá*. While its fruit is not edible, the leafstalks contain a fiber which, extracted and cured, enters the commerce of the world as "Manila hemp."* This is the best of rope fibers. Not long ago, a steamer that had been sunk during World War I was raised. In its cargo were bales of Manila hemp so little affected by 20 years under salt water that it was still strong enough for rope. Abacá "just grows" at the base of Mayon Volcano, but Nature requires that a great deal of human effort be expended in stripping it from the leafstalks. The stalks must be cut down, the petioles broken away from one another and pulled beneath a knife which scrapes off the pulp and leaves the long, strong fiber.

In many a house in the villages, the click of shuttles draws one's attention to handlooms. Women are busy weaving Manila hemp into a coarse open cloth called

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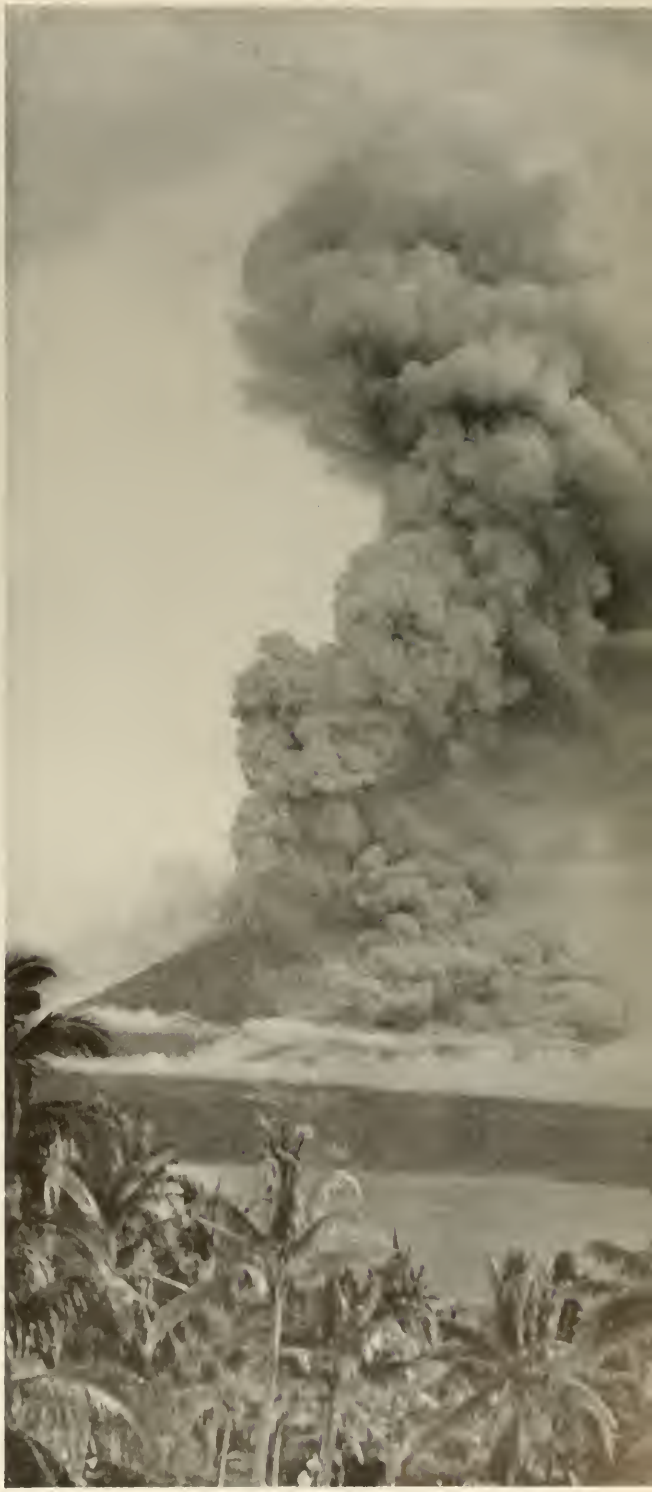
**Manila fiber for rope has been designated as a strategic material because it is still virtually indispensable to the Navy.*



Presently the mountain is enveloped in thick swirling clouds, and the main column rises to the upper atmosphere

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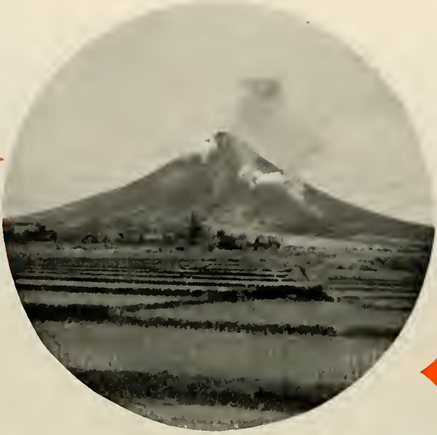
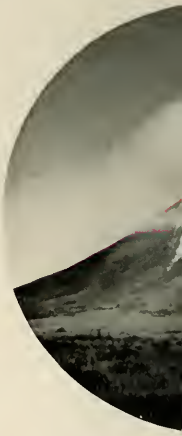
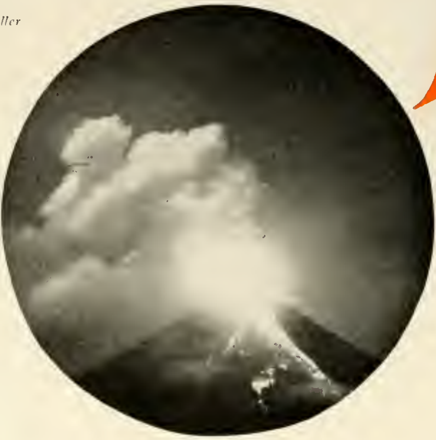
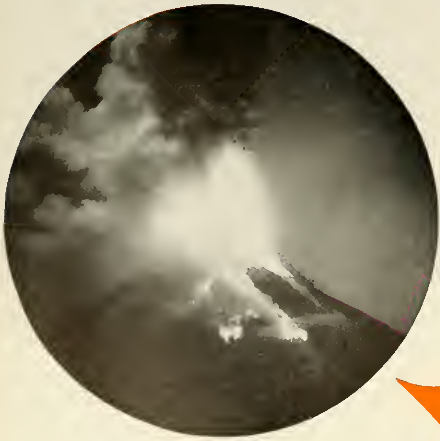
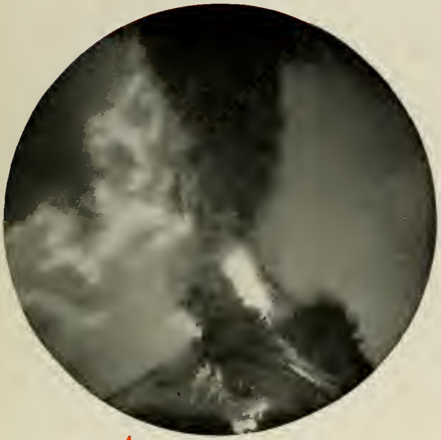
AND INTO THE NIGHT











1 MAYON VOLCANO in silent eruption as evening draws near holds in store an unforgettable spectacle

2 AGLOW WITH RAYS of lambent reddish-white light, Mayon Volcano holds every spectator spellbound when viewed under the full moon as at right. This exceptional photograph was taken with an exposure of about one hour and therefore shows an accumulation of glowing streams not normally visible at any one moment. But there is much more motion of light than is shown in this picture, for a constellation of sparks showers off as each rock bounces along

3 TEN MINUTES AFTER THE LAST EXPOSURE, the author's camera caught Mayon at the beginning of a paroxysmal eruption. A column of incandescent rock has risen in the crater and its light is reflected on a plume of vapor and dust

4 THE FIRST EXPLOSION of the paroxysmal eruption is shown at lower left, in an exposure of about one minute. The cap of incandescent rock is blown to pieces by the gas accumulated under it. Then, with a roar, hundreds of incandescent rocks spill out or rocket thousands of feet into the air, to descend like shooting stars. After the noise of each gas outburst, these stones can be heard falling onto the side of the mountain. This exposure was one minute

5 *(Upper left)* AMID THE GLARE, the tracks of incandescent rocks can be seen, and a column of black smoke rises from the side of the cone. For a few moments the mountaintop is ablaze with brightness. Then black billows build up from the descending tongues of light, and, above the crater itself, an oval of brilliant lustre pierces the pitchy blackness of the cloud

All photos by Hugo Miller

sinamay, and here and there is to be heard the "pin-ok-pok" of wooden paddles beating the sinamay into a crude, linen-like cloth. From the spindly coconut palms the nuts must be gathered for another native industry—the "harvesting" of copra. The split nuts yield the half rounds of white meat, which are dried over fires. Automobile trucks and lumbering carts drawn by slow, plodding water buffaloes, collect these products and bring them to the seaports, where the hemp is baled and the copra sacked. Both are loaded on steamers under the quiet, white plume or the rumbling smoke column of Mayon. From islands and from coast villages, sharp bowed, outriggered proas fold their sails in these harbors along the volcano's shore line.

Earlier eruptions

Except for the people who live in the higher villages, and especially near the larger gullies down which the incandescent rocks tumble, an eruption of Mayon Volcano causes no change in the routine of the day's work. And yet Mayon's list of casualties is fairly high. The Filipino peasant is a stoic. Whatever fear he may have of Mayon, he successfully hides, although he well knows that as late as 1897—the year before the Americans came—400 people perished in the town of Libog. The survivors reported that people fell dead or died where they sat. No autopsies were performed. The victims were quickly buried in one common grave. But among the survivors were those whose skins were badly burned, probably by a sudden rush of superheated steam down the side of the mountain. And the air may have been poisoned with carbon monoxide and other gases, intensely hot. Not far from Legaspi one sees mute testimony of the destructive force of Mayon—the upper half of the facade and the top walls of the nave of a stone church that was buried under an overwhelming avalanche of rocks. This eruption of 1814 took the lives of some 1200 people in the municipality of Cagsaua. A dramatic story is told about a Spanish grandee and a beautiful young woman recently come from Spain. She was in the church, he at the door watching her at her devotions. Hence, when the avalanche of incandescent rock burst from the mountain and spurted down the slope, he was able to escape while she was buried. The ashes of several hundred people lie under the rocks in the nave of the church.

Strange as it may seem, most of the damage from Mayon within historic times has resulted from water. During the Philippine typhoons, or hurricanes, which frequently pass over or near Mayon, the volcano acts as a condenser. Avalanches of water, mud, and rocks rush down the bare slopes of the mountain and flood the plains below. Small brooks turn to currents 50 feet wide and rivers that normally can be forded become raging torrents 200 feet across. Roads, plants, and towns are destroyed by the swift currents or buried under sand and mud and rocks many yards deep. The loss of human life and of domestic animals is very high. In 1875, 1500 people were killed, and the loss of animals and crops could not be calculated.

Mayon Volcano, for all its austere and magnificent beauty, is the Number One potential Philippine calamity-maker. Father Selga watches it carefully, not for any increase in the volume of vapors and the depth of subterranean sounds, but mainly for earthquakes centering in the volcano which may give an indication of dangerous strain and activity in the reservoir of molten material. Father Selga served as adviser to Governor-General Stimson and President Quezon respectively in the eruptions of 1928 and 1938. Over 25,000 people were moved from their towns to evacuation sites in 1928; and about 10,000 were transferred from their *barrios* to safer places in the eruption of 1938. The work was hard, the responsibility was great, but his happiness is greater because not a single life was lost.

How restless, Mayon?

Is any volcano really dead? Thirty miles from Manila, in prehistoric times, a volcano disappeared and left in its place a lake and in the lake the volcanic island of Taal. In 1911, Taal snuffed out over 1000 lives in a violent explosion, and since then it has been popularly considered among the dead volcanoes. But is it only plugged?

Is any quiescent volcano to be trusted? I decided contrariwise when I was taking a picture three miles from the crater of Mayon and saw a sudden burst of gray dust rush down at me in a gully that had previously not been occupied by any tongue of sudden death.

Since Mayon stands by the sea, some people are afraid that the ocean may flow into it, causing steam that will blow the mountain to pieces in a cataclysmic eruption, such as Krakatao's in 1883 and Taal's in 1911. And yet, peasants will continue to raise rice and make copra and strip Manila hemp on the base of Mayon Volcano; and I for one, if it again goes into action, will hasten there to see it. Unless Mayon is blown to pieces by accident, its activity will probably lessen, and the mountain may finally fall in on itself. However, this change will cover geological years, and in the meantime there will be many opportunities to see Mayon in eruption.

Adventures of

AN ARTIST-EXPLORER

The varied career of James L. Clark, sculptor, executive, and big-game hunter on three continents, is one of the most exciting in the annals of the American Museum

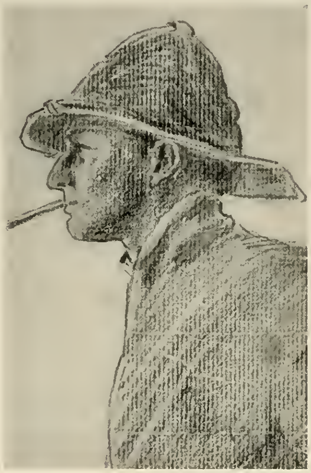
By D. R. Barton

The explorers and scientists who have filled the American Museum with many of the treasures it holds today are busy men, deeply absorbed in their departmental affairs, and their offices not infrequently betray this preoccupied state of mind. For these curatorial dens are usually characterized by that frank and honorable clutter which has been, time without end, the jealously guarded privilege of the male animal.

In sharp contrast to such profoundly academic and agreeably tobaccoy disarray stands the office of James Lippitt Clark. Here you are simultaneously impressed by the individuality and by the tasteful arrangement of its appointments—the zebraskin screen, the dark, subdued, peculiarly hushed tone of the furniture, the restraint in distribution of numerous bronzes and other objets d'art. The sensation is quite like that of having somehow wandered into the reception room of a Fifth Avenue dealer in fine art. As Doctor Clark removes his black-ribboned pince-nez and rises from the desk chair one fully expects to find him in a morning coat complete with striped trousers and beige spats. But he has no need of such sartorial exuberance. His conservatively groomed appearance jibes perfectly with the New England broad *a* of his speech, the gestures of his well-kept, aesthetic hands. Watching these hands in repose, it is difficult to imagine them as once having been cruelly tortured by bandits or as possessing one of the best and probably the itchiest trigger fingers in the entire Museum.

But then, it is even more difficult to imagine their smooth-cheeked owner sporting a fierce set of unkempt whiskers that would put a Russian peasant to shame, and riding an equally shaggy yak over the bleak Mongolian desert. Such accomplishments are nonetheless an integral part of his reputation as an internationally famous hunter of big game on three continents. Indeed, in a moment of youthful recklessness he planted his feet firmly on the road to fame and fortune by hiring himself out as a sort of personal "trigger man" who risked his own life to protect others from the wild beasts of Africa.

Yet, for all that, the first impression is well founded. Doctor Clark is certainly a dealer in fine art by virtue of his function as ringmaster of the greatest animal art show on earth—the habitat groups at the American Museum of Natural History. And he is himself an artist. There stands in Sagamore Hill, historic home of Theodore Roosevelt, a bronze statue of a rhino, which was one of the immortal President's most cherished possessions. It is the work of James L. Clark. Doctor Clark has about 30 other bronzes to his credit in addition to innumerable mounted animals, all, of course, faithfully sculptured in clay after the revolutionary method taught him by Carl Akeley. Unquestionably Akeley is the founder of modern taxidermy but James L. Clark is its major prophet. His patient skill as a teacher, combined with his executive ability, has enabled him to impart this artistic technique to others and thus develop one of the finest staffs of craftsmen ever to be assembled anywhere—the Museum's Department of Arts, Preparation, and Installation, which he has supervised since 1923.



John T. McCutcheon

James L. Clark

Tip

Though he left school for good at the age of fifteen,* Jimmy Clark rose to become temporary vice-director of one of the world's outstanding educational institutions while still in his forties. Born and raised in Rhode Island, he visited New York occasionally during childhood and was even then familiar with the building wherein he was later to make so illustrious a name. In those days anyone strolling along 77th Street who chanced to glance in the direction of the Museum would be confronted by the ominously looming posterior of a mounted ex-circus elephant named Tip, which was clearly and unabashedly visible through a large window. This struck Jimmy as amusing but a sad commentary on the alertness of the Museum's exhibition planners. He resolved then and there that if ever he had anything to do with the institution, Tip would be withdrawn to some position where his rear would not be so flagrantly exposed. As a matter of fact, this maneuver was effected without Jimmy's assistance, but not many years intervened between his first sight of Tip and the day that he was brought down from Providence by Museum Director Harmon C. Bumpus.

The latter, himself a Providence man, had been seeking a young sculptor among those studying in the Rhode Island School of Design. Jimmy was chosen from the lot although he was only eighteen at the time and labored under the added handicap of having to study at night, since he was compelled by day to earn a meager living in the designing room of the Gorham Silver Company.

One morning a few months after Jimmy Clark arrived at the Museum a stranger approached his workbench.

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*His degree is an honorary doctorate of science, conferred by West Virginia Wesleyan College in 1933.

This man had the rough-hewn Lincolnesque countenance we are accustomed to associate with the pioneer, and he was, in fact, a pioneer in his own right for locked within his brain lay the secrets of an unprecedented method of mounting animals based on the ingenious use of that most fluent and delicately expressive of all sculptural materials—water clay.

Clark, of course, had no notion that this stranger was Carl Akeley. He simply went about his business as unselfconsciously as possible under the man's relentless scrutiny, until Akeley introduced himself. They conversed for a while; then Clark settled down to await developments. These came with dazzling rapidity and with such far-reaching effect as to prescribe the broad outlines of Jimmy Clark's career for the next 35 years.

Akeley left the young sculptor for Bumpus's office. "I have found the man at last," he told the Director. "If you will send this chap Clark to me at the Field Museum, I'll teach him all I know. I've seen him work, and he's the only one I'd be willing to trust with my method."

Carl Akeley kept his promise. During the two months' apprenticeship at Chicago he passed on the secret of his technique, and though Clark was soon back in New York applying what he had learned, their relationship as master and closest disciple was to continue throughout Akeley's life. And perhaps even at this early date it was foreordained that the disciple's major work would lie in the fulfillment of the master's greatest vision.

It must not be supposed, however, that Clark was a mere instrument in Akeley's hands. His function may better be visualized as a sort of forceful and highly gifted junior partner who contributed not only a superior executive ability but much in the way of creative innovations and improvements.

One morning Clark picked up the phone to find himself connected with a prominent actress who explained that she was deeply grieved to learn that her favorite riding horse had just died and she hoped the hide could be fitted over a lifelike mannequin sculptured by Doctor Clark in the usual Museum manner.

"Can you do that?"

"Certainly," he replied, "whatever can be done with a wild animal can be done with a horse." He wondered, however, if he might make so bold as to inquire what she wanted to—uh—do with the mannequin once she got it in her home.

"Why," the lady exclaimed sweetly, "what an absurd question! Naturally, I want to ride it."

There was a brief pause. "Then," said Doctor Clark, "in that case I'm afraid I'll have to do a little figuring. May I call you back?"

Here was a problem. Museum animals are, of course, not stuffed. They are simply hollow shells of papiér-mâché, so light that a school girl could shoulder a zebra with ease. But she couldn't *ride* it very long without inducing partition or at best a decided sway-back. However, there is obviously considerable mechanical talent required of a man charged with building Museum groups, and it is a qualification which Doctor Clark possesses in abundance. Once he had put his mind to work on the problem he soon came up with an idea for bracing the body walls of a mounted specimen so that it could support an astonishing amount of weight without sacrificing its own easy portability. This innovation was tried out on the actress's horse with complete success. So far as Doctor Clark knows she still bestrides the mannequin on imaginary canters about her boudoir. But the important result of this episode is that all the Museum's larger animals can now serve as riding horses so far as load capacity is concerned. For Doctor Clark saw at once that the bracing of the animal's rib case for greater durability was a valuable extension of Akeley's method.

This was the only one of the several improvements the disciple has made which was suggested via the vagaries of the theatrical mind. The others evolved over the years from his patient and never-ending study of animal anatomy and behavior.

Paradoxically, the disciple had to resign from the Museum before he gained any appreciable firsthand knowledge of animals. About six years after Bumpus imported Jimmy Clark from the Rhode Island School of Design, that young man entered the Director's office and asked for a leave of absence. He reported that he had a chance to go to Africa with an outside expedition and he felt that here was the opportunity of a lifetime and that any man who wanted to make a profession of animal sculpture would be a fool to pass it up. Bumpus considered for a moment and then asked Jimmy if he valued the opportunity sufficiently to resign. It was a critical moment. Jimmy bit his lip, wavered, but finally

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proved the strength of his conviction by sacrificing his Museum post.

As a matter of fact, opportunity had not knocked at Clark's door. Rather, it had been the other way around. This was 1908, when everyone was Africa-conscious as a result of the wave of newspaper ballyhoo following Theodore Roosevelt's announcement of a projected hunting trip to the Dark Continent. *Collier's Weekly* commissioned a well-known photographer of that day named A. Radcliffe Dugmore to go out there in advance and get big game pictures. Clark knew Dugmore slightly and begged to go along. The photographer refused at first—even though Clark asked only his keep in the field. Then Jimmy stressed the dangers of photographing wild game in action. "You'll need a bodyguard," he pleaded, "someone to keep a gun on the animal while you're busy with the camera." Dugmore admitted the wisdom of this arrangement and relented.

When they debarked at Mombasa, the trusty bodyguard hastily sought a secluded area to try out the rifle he had just purchased. "I couldn't hit a tomato can at three feet," he says recollecting the incident, "but, of course, I didn't mention that to Dugmore."

So off they went into the field the cameraman blissfully ignorant that he had placed his life in the hands of a mere tyro—a 23-year-old sculptor who knew little of guns and absolutely nothing of African wildlife. But it was a case of sink or swim with Jimmy Clark, and he gained experience of both in a hair-raising "cram" course that few men could have survived.

By prearrangement Clark never fired until he heard the click of the camera's shutter. And when you are faced by a charging rhino, bearing down on you at express train speed—that takes nerve. Squinting along the barrel of his gun, Jimmy would see the whole landscape blotted out by this huge, black, onrushing mass. Nor is there any guarantee that a bullet will turn the brutes. Many a time Clark had brought them down stone dead a few precious feet short of their goal. But on one particular occasion the rhino kept coming even after both barrels had been discharged.

"His momentum," writes Doctor Clark, "carried him by as I turned to face him, but he instantly wheeled and rushed at me. Again I side-stepped and fired [my revolver] into his face, and again he went by with a rush and wheeled. A real battle was on, and for a few quick moments it was nip and tuck. Each time he rushed I side-stepped and pulled the trigger until six shots from my revolver were fired into his head, but with no more effect than to make him shake his head as if a bee had stung him. At the last rush, with my revolver empty, I dashed clear to one side . . . "

Eventually, the creature galloped away, apparently in fine fettle despite a deep spear wound and eight bullets buried in various parts of its body.

"On another occasion," Doctor Clark continues, "when Dugmore had left Africa and I was protecting Cherrie Kearton on what was probably the first motion-picture expedition that ever made cinema records of African game, I had a demonstration of how suddenly and unexpectedly these blundering beasts can appear. . . . Every one of us turned to run [from the rhinos], for they had come so quickly that we had no time to think. But after two or three yards I realized that I couldn't outrun them, and furthermore, the tree nearest which we were was already sheltering the two *askaris*, the water boy, and Kearton. The result was that I turned to fire. But by then the two ungainly animals were down in the dry stream bed and I could see only the tips of their horns and the tops of their backs. There was no target, and I had to wait. In a moment they were climbing the bank, and I pulled one trigger. To my horror the gun did not go off! I pulled again! another misfire! And by now both those rhinos were within five yards of me. I turned and ran, passing close beside the tree. I remember seeing Kearton kneeling and aiming.

"'Fire, Kearton!' I cried as I passed and I heard his gun go off. One of the rhinos was close behind me, I knew. How close I could not tell, but hoping to throw him off his charge I changed my course to the right, to bring me behind the tree, past which, by this time, I had gone about three or four yards. As I turned I was reloading, and out of the corner of my eye I saw a fearful situation. Kearton had fired at the rhino that was after me while the tree obscured the other. The rhino he hit hesitated for just the fraction of a second that made my get-away possible and then came on, while Kearton, thinking to dodge him, darted around the tree and almost ran squarely on to the other's horn. He saw his danger in time and stopped just as the rhino went past not more than three feet away. Then, to their everlasting credit, the two Masai spearmen went into action. One was facing each way, and as the rhinos went past the tree each thrust with his spear. The attack was too painful and sudden to be resisted, and by great good fortune, the two rhinos parted, one going in each direction."

The Africa of 1909 was still in that frontier stage of a country's development wherein meteoric rises are the order of the day and the wonderful legend of Cinderella may be realized overnight. On this first visit, Clark remained only fourteen months. But he emerged a made man.

His luck held through all the hair-breadth escapes from charging animals, and he leaped from one job to another as nimbly as a lumberjack in a log jam. Almost the moment the Kearton expedition ended, a messenger reached Clark's camp from none other than Carl Akeley, who had landed in Africa with the mighty T. R. himself. They were outfitting an expedition to collect a group of four elephants for the American Museum, and Akeley invited Clark to join the personnel.

Thus the tenderfoot bodyguard who eight months before couldn't hit a tomato can at three feet had become a sought-after veteran of the field. Professional African hunters working with the Akeley-Roosevelt expedition were aghast when told how he had covered onrushing rhinos for the photographer. Said one of them, "Why, man, there isn't money enough in the world to pay me to do that. I *know* those animals." Clark had done it merely for his keep. Yet there was an additional reward. He had accomplished his sworn purpose of gaining a firsthand knowledge of wild animals. Henceforward he meant to make that knowledge yield dividends.

Perhaps the happiest moments on this safari were the fireside pipe talks with Carl Akeley in the long evenings following grueling days on the trail. It was then that the master opened his heart to the young disciple and revealed his dream of a great, million dollar African Hall, conceived as a memorial to the teeming game that inevitably would vanish from the no-longer-Dark continent. Even then Akeley saw the elephants which they were engaged in collecting as only the nucleus in the finished Hall. He envisioned other expeditions, many of them. He wished to return again and again, for he was a man who had pledged his life to Africa.

Clark learned other things from Akeley on this trip—practical things that hastened his growing mastery of taxidermy. And when, toward the close of the expedition, Jimmy joined Kermit Roosevelt's safari, the President's son asked him to take complete charge of mounting his many trophies and those of his illustrious father, in addition to collections for the American Museum and the National Museum in Washington. On the basis of this large order, Clark was able to open his own studio in New York, and soon through his African connections he built up a large clientele of sportsmen with whom he hunted and studied big game in Canada and the American west. Akeley himself used the studio to work on his own specimens after they were shipped to these shores. While thus engaged the two men continued to exchange ideas for the construction of Akeley's dream hall and further strengthened the bond between them.

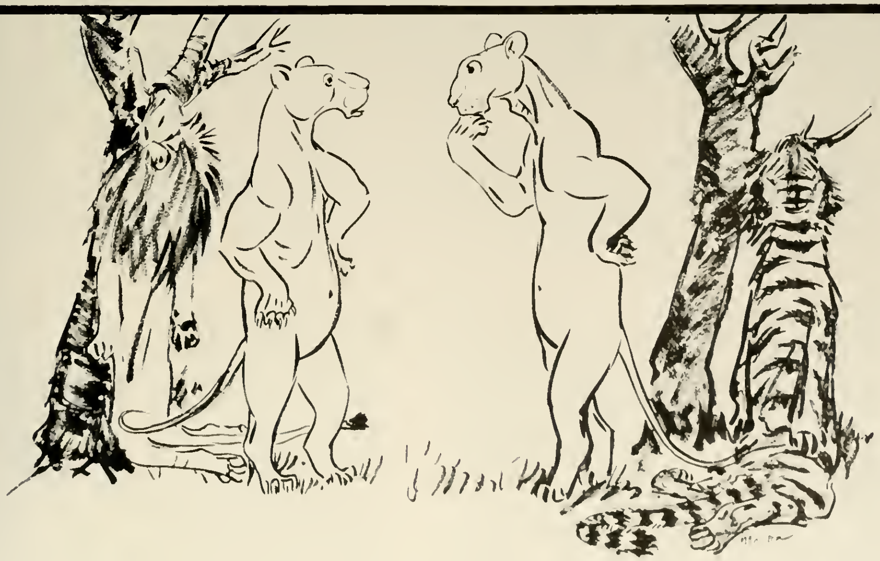
About this time, Akeley began to manufacture his famous moving picture camera, which he had been more or less forced to invent because of the awkwardness of existing models under the complex demands of wildlife photography. When America entered World War I, Clark volunteered for the Naval Air Service but was turned down on account of age. Meanwhile, government orders for the Akeley camera came pouring in and it fell his lot to take over the reins of the company. Clark was manager, vice-president, and then president of the Akeley Company until 1928 when he resigned. During this same period, the Clark studio became the foremost taxidermy establishment in the country and, in 1923, at Akeley's request, Clark was invited to return to the Museum to reorganize and take charge of its Department of Preparation. The master wanted all executive affairs left in the hands of his disciple so that his own time could be devoted without stint to the enormous job of planning, collecting for, and securing financial support of, the splendid edifice that is known today as the Akeley African Hall.

Not that Clark was confined entirely to his desk. In November 1923, he returned to Africa with his wife, spending six weeks in the field. Five years later he went out again to collect the lion group, and on another trip in 1931 his goal was the Giant Eland

Continued on page 62

BROTHERS UNDER THE SKIN

By JOHN ERIC HILL *Drawn by* G. FREDERICK MASON



WHEN seen alive in their native haunts or in the zoo or circus, lions and tigers appear so different that it is often supposed they are equally distinct "under the skin." But on the contrary, the internal structures of these two great cats show remarkable similarity. The inexperienced observer could not tell them apart, and in many cases a specialist can hardly distinguish them.

The lion appears more massive, especially in the males with well-developed manes, and the tuft at the end of the tail makes that member appear shorter. In truth, however, the proportions of body and tail are about the same in both species, and the tiger reaches a slightly greater size, especially as indicated by weight. The tiger usually has a more convex facial profile (indicated in the cartoon) and its lower jaw has a concave lower margin, while that of the lion rocks on a flat surface.

In the few recorded encounters between lion and tiger, the latter appears to have had the best of the argument which, cat-like, was no bout of rules and gloves.

Captive animals of the two species have mated and successfully produced hybrid young tiglons, one of which is on exhibition in the Central Park Zoo, New York City. These hybrid offspring indicate the relatively close relationship between lion and tiger.

A HOUSE OF BUBBLES

By EDWIN WAY TEALE

All photographs by the author

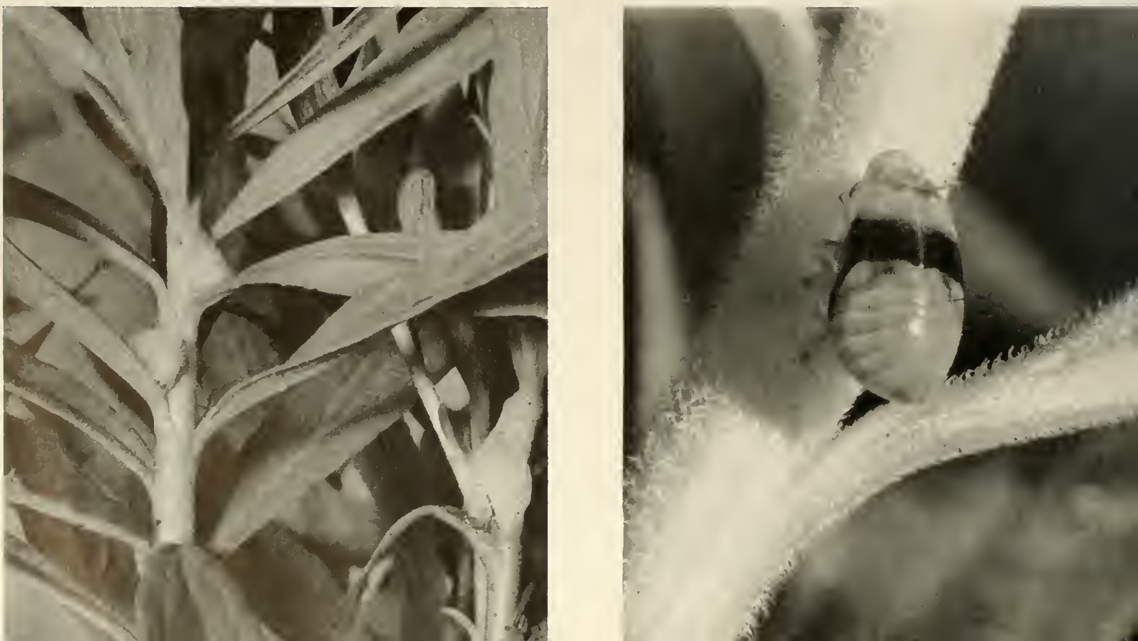
EACH spring, little masses of froth that resemble the beaten white of an egg appear mysteriously on weeds and grass stems. From Aristotle's day to modern times, these masses have been called "frog spit" or "cuckoo spit," under the misapprehension that they are voided by tree frogs and cuckoos. Southern negroes believe horseflies hatch from the bubbles.

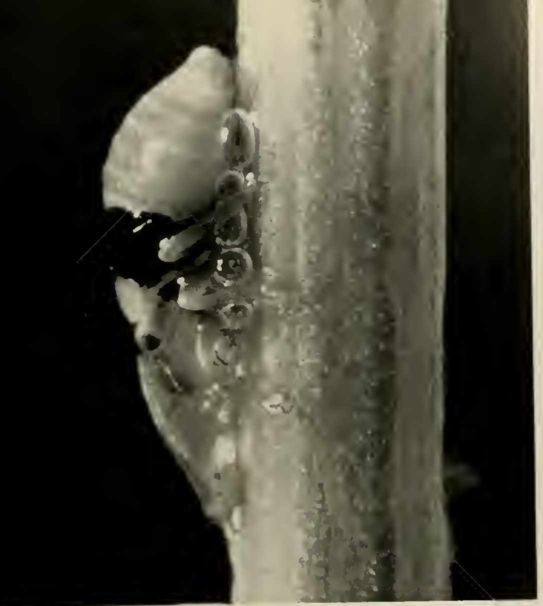
In reality, each little mass of froth is the home of a tiny, soft-bodied bug a quarter of an inch or less in length. Among the more than 600,000 existing species of insects, these spittle-insects, or froghoppers, seem possibly to be the only ones that produce bubble dwellings in which they live, apparently protected from enemies and the heat of the sun. Under their roofs of froth, they drink sap, molt from time to time, and finally, when full grown, develop wings and appear among the herbage as inconspicuous gray or brown insects. From a distance you might think you were looking at an oat kernel—until you were startled to discover its prodigious jumping ability. During the process of growing up, a froghopper may build several of its unique houses of foam. Among scientists, the insects are known as the Cercopidae.

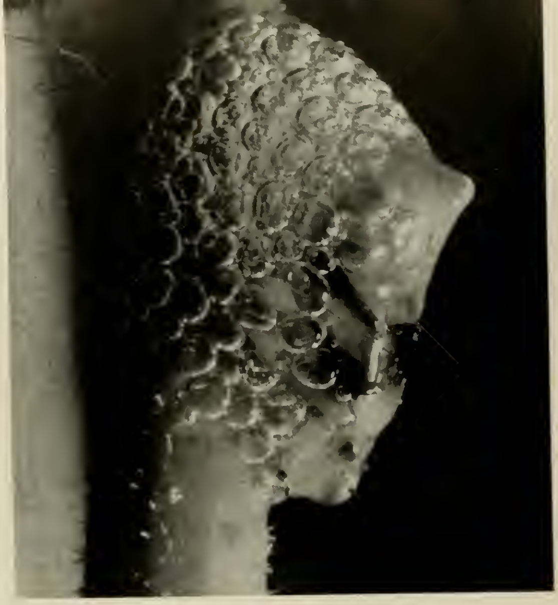
Excess sap from the plant on which the froghopper is feeding is the building material out of which it constructs its dwellings. One cercopid, found on the island of Madagascar, is virtually a living spigot. It draws off such quantities of sap that four or five of the insects are reported to be able to fill a quart jar in the space of a couple of hours. American froghoppers ocasionally become numerous enough to cause some damage to pastures. But on the whole, the Cercopidae are far more interesting than harmful. One species found in Massachusetts is the same as that common in the British Isles and is thought to have been introduced accidentally by early settlers in New England.

Although for more than 22 centuries men have been observing the spittle insects, the curious secret of their bubble-making mechanism has been discovered only in recent years. Previously the insects were supposed either to produce the bubbles from inside the body or to create them by lashing the tail about in the manner of an egg beater. This series of magnified action close-ups, obtained by a new technique employing synchronized photoflashes and a magnifying lens, reveals the successive steps in the construction of the froghopper's unique house of bubbles.

1 THE STORY OF THE FROGHOPPER begins in the spring when the insect hatches from an egg laid in plant tissues the previous summer. Inserting its little beak in some tender stem or leaf, it begins pumping out the sap which provides it with both food and shelter. The insects select a wide variety of plants, sometimes even poison ivy. Half a dozen masses of froth may be found on a single plant, and occasionally more than one of the squat, immature froghoppers will be discovered inhabiting the same froth-mass





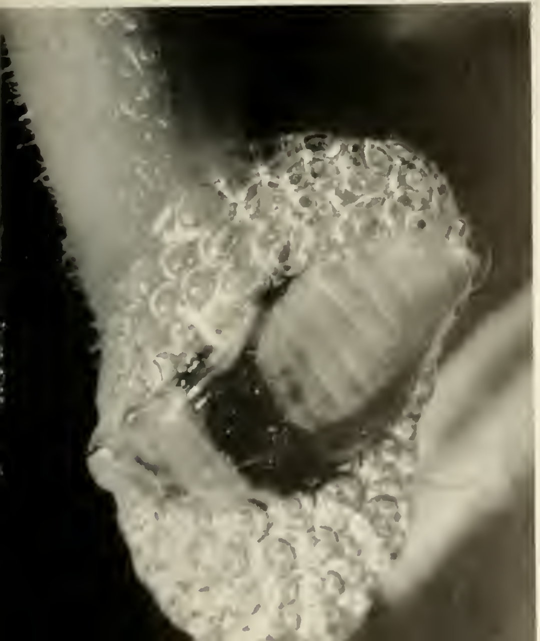


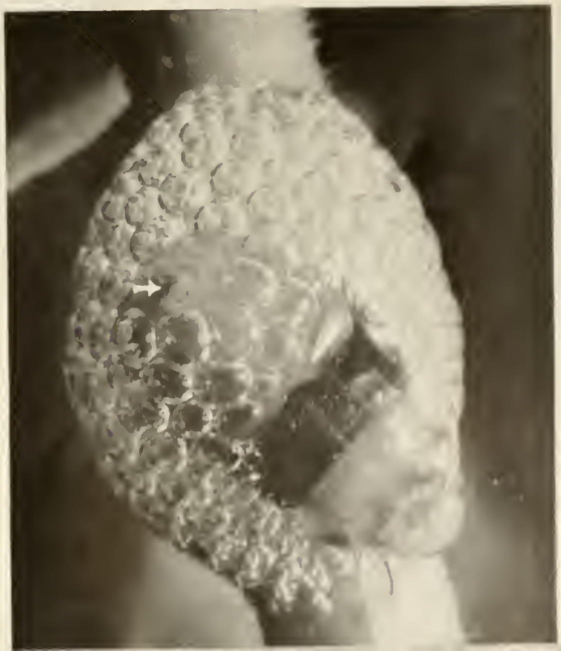
IN STARTING the production of its curious shelter, the froghopper always takes its position head downward n the plant. Thus gravity helps pull the mass of froth, hich is produced at the tail, down over the insect. As the rst bubbles are made, the hind legs also assist in pulling hem downward. The initial bubbles, forming the "founda- on bricks" of the future froth-mass, are seen here in the ool of sap

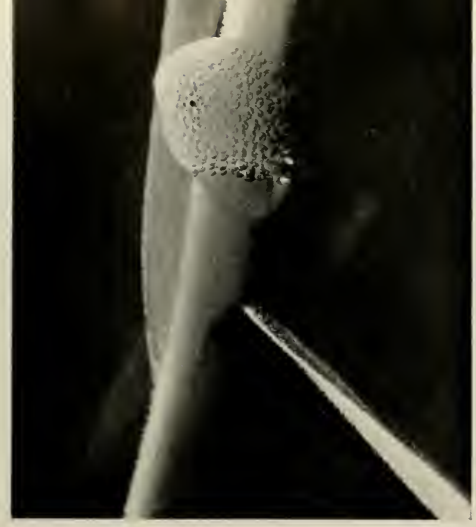
3 MOST OF THE BUBBLES in the mass are approximately the same size. This is because of the mechanism by which they are produced, a mechanism unique in the animal kingdom. Along the underside of the abdomen two rows of opposing plates, or scutes, overlap to form a channel outside the body. Each time the tail rises above the pool of sap, as shown above, the terminal plates separate slightly and air is taken into the channel. When the tail is depressed again, the air is forced out in the form of a bubble

HERE the insect pump is caught in action. The bubble is forming as the tail descends. Like a steadily operating achine, the froghopper raises and lowers the tip of its abdo- en, producing its bubbles at the rate of about one a second. his continues until from 30 to 50 have been made. Then the sect rests for a while before beginning again

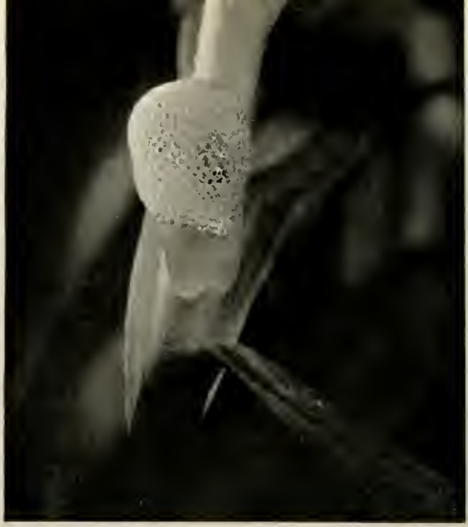
5 THIS TOP VIEW of the froghopper at work shows the triangular opening formed by the terminal plates, as indicated by the arrow. Through this opening the air enters and leaves the channel beneath the insect's abdomen. Glands within the body of the cercopid are believed to add chemicals to the sap, thus making the fluid more resistant to evaporation. Bubbles are proverbially short-lived, but those produced by the froghopper remain intact for many days







6 As THE INSECT DISAPPEARS from sight, entirely covered by the mass of froth it has created, excess fluid begins to collect at the bottom of the cluster of bubbles. In this photograph, it is seen forming a single large clear drop



7 THE DROP SUGGESTS glycerin, rather than water. The fluid is slightly viscous and stretches farther and farther down the stem, draining away all the liquid not used in the formation of the bubbles

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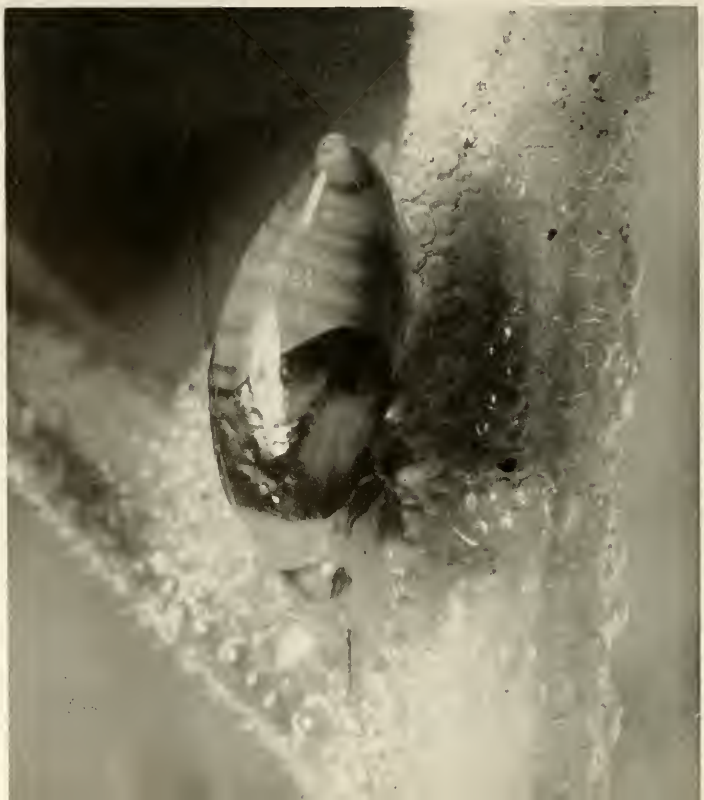
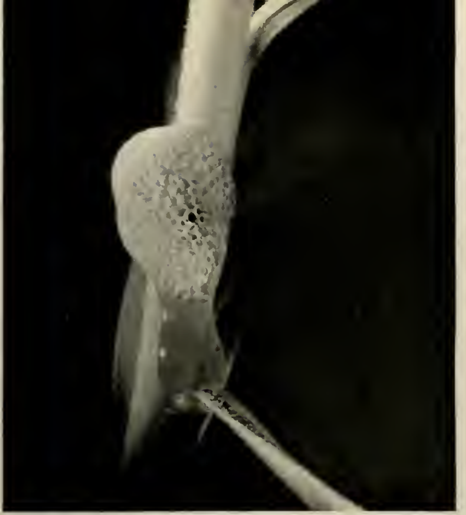
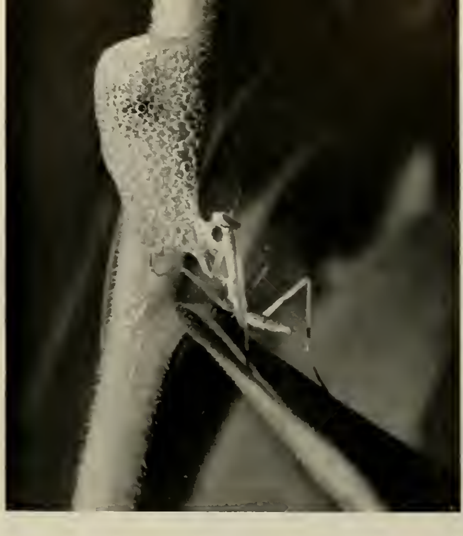
10 DURING THE LAST STAGES of its stay within its bubble-house, the immature cercopid begins to develop wings. The growing wing pads, darker in color, can be seen in this picture of a froghopper temporarily driven from its hiding place



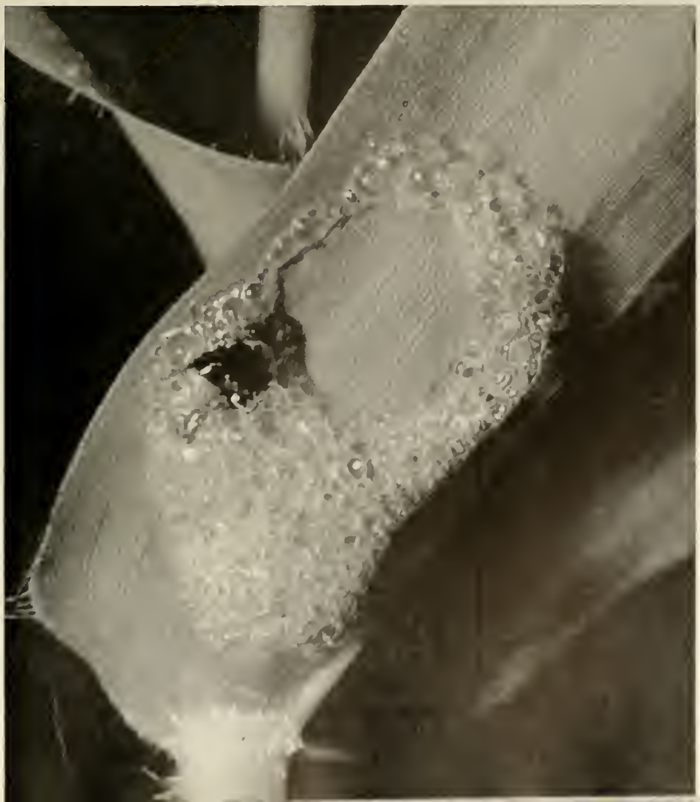


8 JUST BEFORE the drop separates from the bubbles, the fluid assumes this shape. Eventually it runs down the stem of the plant, leaving the mass of froth, covering the cercopid, attached to the stem



9 SMALL FLIES and other insects often become embedded in the froth, which remains sticky for days, like whipped egg white. Sometimes as many as a score of minute flies can be found attached to the outside of a single small mass of froth. Larger insects, such as the young praying mantis shown in the picture above, are capable of pulling themselves free

11 THE FINAL MOLT occurs within an open space hollowed out in the drying mass of bubbles. Here, the froghopper sheds its skin for a last time as it becomes adult. The dried foam and the discarded skin of the insect, as seen below, are all that remain behind. With wings and jumping legs to aid it, the insect no longer requires the protection of its curious house of bubbles



Natural History

ILLUSTRATIONS

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COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration painted by F. L. Jaques, from Bird Group of Hudson Bay Region in the American Museum of Natural History

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BIG PICTURES FROM LITTLE THINGS

By CHARLES H. COLES

Chief Photographer,
American Museum of Natural History

THE portrayal of tiny things greatly magnified is always an exciting novelty. Small portions of familiar objects look startlingly different when magnified with a camera lens and often take on a strange beauty. This fascinating technique probably yields the greatest enjoyment when applied to natural objects. Tiny shells, specimens of rock or wood, portions of leaves, bits of feather, and minute seed pods look strange and unrecognizable when photographed many times their natural size.

The sort of picture-taking that involves the magnification of small objects up to about 25 diameters is neither ordinary photography nor photomicrography but lies somewhere between these two realms. Ordinary photography is generally considered to leave off when the image on the film becomes greater than the object photographed. At this point we enter the field of photomacrography.

Lenses for photomacrography

In this branch of photographic work, depth of focus becomes a difficult and important problem. It is hard to get a sharp focus, for example, on different parts of an insect's head that lie at different distances from the lens. Special lenses made for this type of work are equipped with diaphragms that enable the operator to narrow the lens aperture to achieve greater depth, but a limit is quickly set by that bane of the microscopist—diffraction. Because of this effect imposed by the size of the light wave itself, the detail of the image becomes obscured as the diaphragm aperture is closed. A compromise must be reached between the depth of focus required and the amount of detail needed for the most important parts of the object. Only by careful study of the image on the ground glass focusing screen can the best aperture be determined.

Special lenses are manufactured by various optical concerns for the specific job of magnifying small objects. The term "micro" usually is part of the name of these lenses, although they are built for "macro" work. Micro-Tessars and Micro-Teleplats are two American-made lenses designed especially for close-ups. They come in focal lengths of three inches, two inches, an inch and a half, and a half-inch, depending upon the magnification required. The two-inch and three-inch lenses are by far the most useful, and both also make excellent lenses for use on your enlarging camera.

Ordinary camera lenses may be used for photomacrography, but as they are not designed for such work they will not produce as sharp an image as the special lenses. Lenses made for use on amateur motion picture cameras make rather good "macro" lenses. For better results when using anything but the special lenses, it is advisable to reverse the lens so that the back of it faces the object being photographed. Of course, you probably cannot adjust the diaphragm as easily with the lens in that position, but better definition will result in the picture, because the lens correction will be superior. Ordinary camera lenses are designed to work from a large area (subject) to a small area (film). In photomacrography, the subject becomes the small area and the film the large area; hence the need for reversing the lens.

The camera

The camera for photomacrography should be equipped for ground glass focusing. A miniature camera so equipped is satisfactory for such work when lens extension tubes are used. A larger camera, on the other hand, permits greater initial magnification because of the larger film it uses. A long bellows extension is a great help in increasing magnification and maintaining depth of focus. If the camera is designed to operate vertically rather than horizontally, greater convenience will be enjoyed because it will be easier to support the objects under magnification.

In ordinary photography, the shorter the focal length of the lens used, the greater is the depth of field for any given aperture number, but when working with photomacrographic equipment, a reversal of the usual rule is observed. A six-inch focal length lens will then have a greater depth of field than a two-inch lens but will require an extraordinarily great bellows extension to achieve a magnification comparable to that obtained by the shorter focus lens. A compromise must usually be reached by using the maximum bellows available and then fitting a lens which will give the required magnification.

A point to keep in mind is that still further enlargement of the subject can be achieved by enlarging the negative. This type of enlargement does not add to the detail recorded, but as the film will usually record more than can be seen with the unaided eye, enlargement from the negative brings up this fine detail to a size that the eye can appreciate.

Lighting the object

In photomacrography the lens usually has to be placed so close to the object that illumination is not easy. Baby spotlights or microscope lamps are the most convenient sources of illumination. The smaller the lights, the closer they may be placed to the camera. Lighting is simplified by mounting the camera lens at the end of a tube. In this way the body of the camera does not interfere with placing the lamps in a position to light the object from the front.

It is important to illuminate the background behind an object as well as the object itself. A dark background is desirable when photographing a light-colored object, and vice versa.

In scientific work, photomacrography is

Continued on page 64

YOUR NEW BOOKS

UNDER THE SEA-WIND: LIVES OF SEA-BORN CREATURES
WORLD OF BIRDS: UNIVERSAL LANGUAGE OF BIRDLORE
HEAD-HUNTER BY THE ORINOCO ● MAN, A SOCIAL ANIMAL

ABOUT OURSELVES

- - - - - - by James G. Needham

Jaques Cattell, $3.00

MOST zoological treatises on man are content with placing him in the hierarchy of nature, tracing his evolution, establishing his relationships and completing the job with comments on his comparative anatomy. Professor Needham has a fresher viewpoint. He does, it is true, begin at the beginning with a clear, succinct description of man's zoological position, but after this preliminary orientation he launches into human behavior from the biological aspect, and then broadens his scope to deal with man as a social animal, emphasizing throughout the fundamental organic principles involved.

Naturally, since these are subjects of enormous extent the treatment accorded them is necessarily brief and cursory. Nevertheless, he has succeeded in presenting in completely simple and direct language a fascinating exposition of the essential nature of man. It is an account designed for popular reading and should be an admirable introduction for lay readers into a vast and complicated field.

H. L. Shapiro.

UNDER THE SEA-WIND

- - - - - - by Rachel L. Carson

Simon and Schuster, $3.00

WHILE Rachel Carson is gifted with a magical imaginative faculty that enables her to project herself into a world far removed from mankind in the scale of being, she also possesses remarkably accurate powers of observation and a quickened, almost instinctive perception of the motivating causes underlying the activities of that world.

In *Under the Sea-Wind*, she has put these faculties to full use. The changes of the tides, the ocean currents, the growing promise of spring warmth, and the winds blowing from the sea start mysterious migrations of sea life from birds and fishes to the tiniest invertebrates of the plankton. These streaming seasonal mass movements, associated with birth of new generations, competition for food, and changing phases of rhythmic life histories, become the theme of this vital book, as the author follows them through their successive stages.

First, she accompanies the sandpipers in their migration from a Carolina beach to the Arctic and back, in the fulfillment of their racial destiny. Second, she visualizes the mackerel, born in the open sea by the billion, destroyed by the million, struggling through many vicissitudes as they pass their phases of growth and migrate to the shallows of quiet harbors to spend their adolescent period until autumnal storms and cold drive them once more to the deeps, eventually to spawn and thus complete their cycle of life. Finally, this saga leaves the sea temporarily to penetrate the hills to an upland pond where the sluggish eels for ten years have fed and grown large and fat until suddenly, one fall, the impulse comes upon them to join with hundreds of other eels in a mass movement to the ocean to search out their original birthplace in the deeps near the Sargasso Sea.

The magic of Miss Carson's pen paints the absorbing lives of these sea-born creatures so vividly that, like the author, the reader seems to lose his human identity and becomes, for the time being, an inhabitant of the watery world.

Roy Waldo Miner.

WORLD OF BIRDS

- - - - - - - - - -by Eric Parker

Longmans, Green, $3.00

ALTHOUGH the author's world of birds does not include America, he speaks the universal language of birdlore. Bird-lovers in this country will do well to add his volume to their libraries.

We may also suggest that Mr. Parker consult, if not, indeed, acquire the standard American works on birds. In them, for example, he will find information concerning the rolling call of woodpeckers that English books apparently do not give to his satisfaction. Strangely enough Mr. Parker expresses his belief,—one that few, if any, American ornithologists share—, that this call is vocal. Who, for instance, that had seen a flicker's evident preference for a tin leader pipe as a drum, would doubt that it used its bill as a drumstick? While of the role of the hairy woodpecker, Forbush in *Birds of Massachusetts*, Volume II, page 258, writes: "On bright March days this bird begins to practice what is either a love song, a challenge, a call to its mate, or all combined. This is no vocal music but instead a loud drumming on some resonant dead tree, branch, or pole."

As more readily available, we also refer Mr. Parker to Witherby's *Handbook of British Birds* (Part IX, 41), a work that we in America accept as authoritative. Here the call of the British great spotted woodpecker is described: "A loud grinding rattle, which apparently functions as a song, is made in spring by extremely rapid and vibrating blows of bill on trunk or branch of a tree."

Mr. Parker also throws doubt on the accepted explanation of the snipe's (*Gallinago*) drumming by quoting the observations of a correspondent who writes that he has seen the bird produce this sound while "on the ground, standing perfectly still with the exception of a definite movement in the throat."

In his final chapter, "Bird Song in Poetry," Mr. Parker deals with less controversial subjects; here the poet has an advantage over the professional ornithologist. What he writes remains for all time as he wrote it. *The Birds* of Aristophanes is still *The Birds* of Aristophanes, but the birds of Aristotle are more or less a curiosity. Moreover, the birds of the poets know no faunal boundaries, and here, therefore, we may meet with Mr. Parker on common ground.

F. M. Chapman

I WAS A HEAD-HUNTER

- - - - - by Lewis V. Cummings

Houghton Mifflin, $3.00

PERHAPS unequalled in recent books of nonfiction is the unique story which the author tells of his experiences in the upper Orinoco basin. Starting alone with a minimum of equipment from Bogota, Colombia, the seven-month journey across the mountains and down the upper reaches of the Guaviare River is summarized in one all-too-brief chapter. The balance of the book is the narrative of nearly a year and a half spent with a small, isolated tribe of head-hunters. His experiences include an initiation ceremony, a head-hunting raid, the daily life and routine which he shared, and even his simultaneous marriage with three of the girls. Much is new ethnological information, as the presence of a tribe accustomed to preparing shrunken human head trophies had not previously been reported in the Orinoco basin. He has written candidly and sympathetically of these people, who won his respect and affection. A few of his observations, as presented, may be open to question, but to check these one would almost have to duplicate his experience, and it is extremely doubtful if a candidate could be found, willing to attempt this

Junius Bird

LETTERS

SIRS:

The arrival of NATURAL HISTORY is a special event each month, and we treasure and file each copy.

. . . My sincere admiration to you, who publish the finest magazine in America!

GEORGE PEPPER.

Los Angeles, Calif.

* * *

SIRS:

I have been reading with a great deal of interest the various articles in the October number of NATURAL HISTORY. I am particularly interested in your story entitled "Quads on Parade," in which the mother black bear with four cubs is so well described.

I notice in the first paragraph of this article that the mother bear is rated "as the most exceptional mother in beardom." I don't know whether this is because she is the mother of four cubs in one litter, or whether it was because she was such a clown. If the four-cub record is the cause, I have one that will equal that.

Late in May of 1926 I was hunting Alaska brown bear on the Bering Sea slope of the Alaska Peninsula with Andy Simons of Seward, Alaska, as guide. One morning we were crossing a broad valley with very little cover, and had the opportunity of watching for more than half an hour a mother brown bear with four cubs. None of them was larger than a cat. When she came to small, wide, but shallow streams she could induce one or two of them to wade across with her, but those that didn't wade she had to take by the back of the neck and carry across.

We did not get a photograph of them, because we were afraid that if she discovered us she might attack, and the last thing that we wanted to do, of course, was to shoot a female bear, especially one with four cubs. . . .

Andy Simons, who has been in Alaska 30 or 40 years and, I think, has hunted every year, told me that he had never before seen or heard of four brown bears in one litter.

EDWARD I. GARRETT.

Seattle, Wash.

* * *

SIRS:

Please find enclosed ten cents including the cost of postage for this month's [November] cover of NATURAL HISTORY.

. . . May I express deep appreciation for your magazine. I find it a great help in the type of work that I am doing, particularly in summer camps.

ERLE ULLEY,
Boys' Work Secretary.

Y. M. C. A.
Kingston, Ontario

* * *

SIRS:

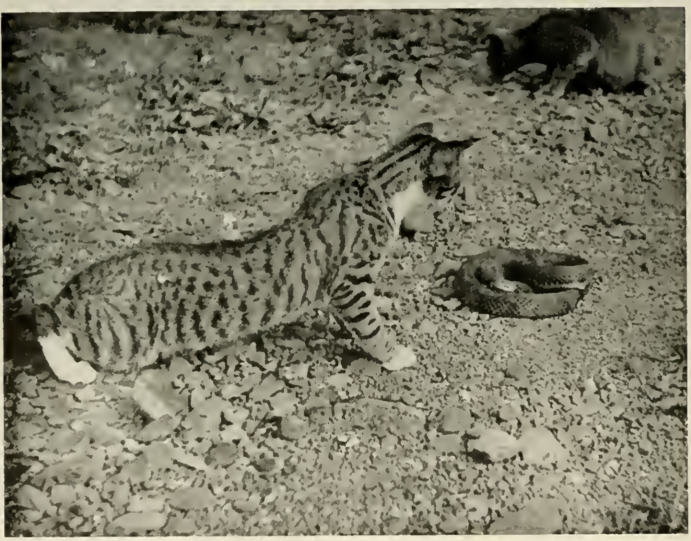
We have two cats, a Maltese and a "tiger," and these photographs were taken when they were carried outdoors to have their first look at a copperhead snake. Both evinced, in different ways, marked fear of the snake. It measured 40 inches in length, and the diamonds on its back were perfectly matched throughout its entire length. The snake had been killed but a short time, and the tail was still moving slightly.

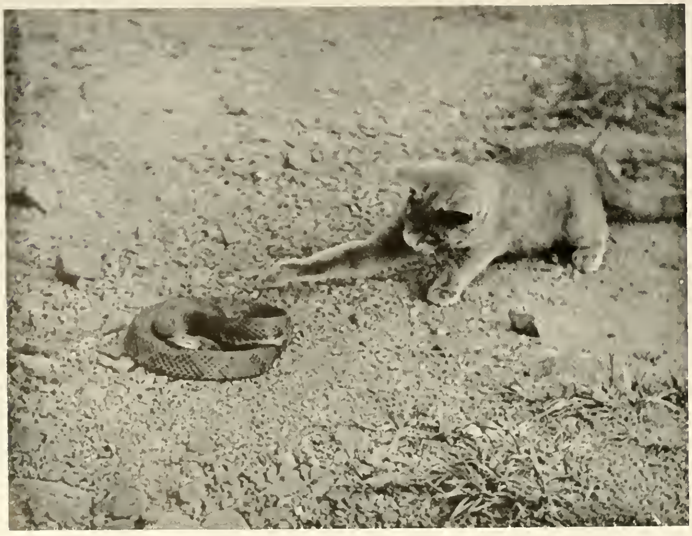
The Maltese, when set on the ground a few feet away, leaped wildly into the air, letting out a frightened howl. Several times he reached out a front paw slowly, cautiously, to dart it forward and tip the snake lightly and then leap backward three or four feet to safety.

The "tiger" cat, the better to investigate, stretched himself to a great abnormal length, not daring to venture too close. His nervousness was scarcely noticeable, yet very stiffly controlled.

Time and again out of curiosity, both would travel in a wide circle, gaining ground each time around. They could either smell the peculiar odor of the reptile or could sense through other means a dangerous foe. Their whiskers and noses twitched nervously and continuously when near it.

Many times during the summer both have chased and caught harmless garter snakes, milk snakes, and such. They played endlessly with one, leaving it partly alive, returning later to continue their play. Time and again one could see them pounce over and over upon something in the grass. Invariably this meant a snake. They showed absolutely no fear of those snakes what-





Continued on page 63

NATURAL HISTORY MAGAZINE
NATURAL HISTORY MAGAZINE

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Central Park West at 79th Street, New York, N. Y.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 64

1. The strategic metal least procurable in the United States is
- (a) Tin
- (b) Aluminum
- (c) Mercury

2. The skunk's odor may turn your stomach, but the skunk himself loves it.

True. . False........

3. Only the male skunk is equipped to carry out an odor attack.

True... .. False........

4. A tiglon is
- (a) A hybrid canine
- (b) A hydrid feline
- (c) A hybrid sea lion

5. When a spotted skunk meets a dog, it
- (a) Observes a time-honored truce with "man's best friend"
- (b) Walks on its hands
- (c) Fights instantly without threatening a "gas attack"

6. Copra is
- (a) Shell money
- (b) Dried coconut meat
- (c) A poisonous snake

7. The ermine, which belongs to the same family as the skunk, fortunately does not have any disagreeable odor.

True....... False........

8. Over 400 persons have died of thirst and starvation on the Devil's Highroad, which
- (a) Parallels the Burma Road.
- (b) Connects two points in Arizona.
- (c) Crosses the Tibetan Plateau.

9. A skunk's ammunition is
- (a) An oil
- (b) A gas
- (c) A volatile liquid

10. I am on the strategic list; I come from a banana-like plant; and many years under salt water fail to impair my strength. What am I?

"Tae your pleasure"

And, there's no question about it when the Scotch is Teacher's . . .

"It's the flavour"

86 PROOF

TEACHER'S
Perfection of Blended
SCOTCH WHISKY

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SOLE U. S. AGENTS: Schieffelin & Co.
NEW YORK CITY • IMPORTERS SINCE 1794

THE ADVENTURES OF AN ARTIST-EXPLORER

Continued from page 53

Group. These three trips gave him a kaleidoscopic view of a changing Africa over a 20-year stretch and prompted him to make a number of sober assessments regarding that country's magnificent but dwindling fauna. At one point in his thoroughly enjoyable book, *Trails of the Hunted,* he osberves that " . . . the African elephant is doomed to extinction. I hope that because of the time I have spent on his trail I have been able to make this majestic animal better known to the world at large, for even in our lifetimes vast changes have come and will come to their mighty herds. There are other animals, of course, that are facing extinction, but the elephant, it seems to me, is the most majestic and the most deserving of a better fate."

Clark admits that in earlier days he has done his share of destruction but against the handful of animals of each species that he has shot, we must weigh the consequent development of his skill at lifelike modeling and the insight that he has been able to communicate in teaching the art to others. Nothing worth-while is gained without sacrifice. The Museum groups that have been raised by Doctor Clark's hand or under his direction stand as immortal tributes to the individual animals whose death was involved in their creation as well as to the entire species represented. Industrial civilization, not the serious student of their anatomy and behavior, is the real and inexorable enemy of the animals.

Bandits

By far the most spectacular of the score of expeditions which Clark has undertaken was from Bombay to Pekin, a 3000-mile trek across the bleakest and most uncivilized part of Asia, with William Morden in 1926-1927. The Mongolian desert is so arid that the explorers grew enormous beards to save shaving water and even packed snow in burlap bags with which to allay their thirst. The quest for those rare creatures, the ibex and the Marco Polo sheep, so necessary to round out the Museum's Hall of Asiatic Mammals, led Clark and Morden hundreds of miles beyond civilization, where few white men ever penetrated before. Clark had known what it was to face the big mammals of Africa at their most ferocious. Here he was to come face to face with what, at its worst, is a far deadlier animal—Man.

On a trumped-up excuse the two white men were set upon by a group of Mongol guerrillas manning an isolated post near the Russian border. The explorers had entered the tent in good faith, leaving their firearms with the caravan, when — but let Doctor Clark tell the tale:

"I saw Morden's captors cross his wrists in front of him, and wondered what would happen now. Then my own were crossed, and they began to bind us.

"For a little time the Mongols had seemed to check themselves, but now, once more, their fiendishness broke loose. A man stood over me and passed a section of rope through his mouth, spitting on it as he did so. I remember thinking that he was placing some curse or other on it, but I had little time to think. My mind seemed clear enough, but my thoughts seemed to have little time for continuity. I had no conception of what such creatures might do. I was trying to outguess them—trying to appear calm—trying to make as little trouble as possible in order that they might restrain themselves somewhat. And now they wrapped the rope about my wrists. Half a dozen times it was twisted about them, and a knot was tied.

" . . . the two who had held me let go my arms. Now they each seized an end of the rope that bound me, and placing their feet against my wrists, they pulled with all their might. They chattered madly and they jerked. Now and then the foot of one or the other slipped from my wrist, and they chattered more wildly yet. I could feel the bones grate together, and I closed my eyes again, expecting every instant to feel my wrists break.

" . . . I saw a big Mongol stoop over the fire and take from it a kettle. It held water, I believe. Possibly it was tea, but whatever it was, it was hot. I saw him stoop over Morden's face, and Bill, who had not made a sound up till now, recoiled.

" 'God, they're going to scald me!' he cried, and I saw some of the water slop over the edge of the pan and fall directly toward his upturned face. I was fascinated with fear. He was to be scalded first and I next. That much seemed certain to me. But Bill jerked his face away, and the water fell harmlessly to the ground. Then it was that I saw what they planned to do. The ropes had been pulled as tightly as it was possible for the Mongols to pull them. But they were not content with that. They poured that hot water over them in order that as our bonds absorbed the moisture they would shrink more tightly still. First they poured the water over Bill's, hands and then over mine. I fully expected the hot water to burn, but it didn't. Already the pain in our wrists was fearful, and the added pain of the water—if there was any—made no impression . . . as the ropes shrank and the circulation was cut off more and more, our hands seemed to burn like balls of fire, and the pains in our arms grew and grew . . .

"We hoped against hope that they would decide to shoot us. It would be so much quicker that way. But we did not expect any such consideration. It wasn't that we were afraid of death. None of us were, apparently. We had a natural aversion to torture, certainly, but death itself was not uppermost in our minds. We would have welcomed a quick death as a means of getting away from our torturers. But more than anything else Bill and I thought of our wives. It would soon be over for us, whichever way things went, but it would be months—possibly years—before they could learn what had happened, and it was possible that they might never learn anything save that we had not returned . . .

"But now we believed that we were bound for the firing line [and] we said goodby. We might not have another chance. [But we were trussed up in another tent where] our guard amused himself by aiming his gun first at one of us and then at another, crooking his finger suggestively about his trigger as he did so. He seemed to gloat over us, and often held his aim for half a minute at a time."

Fortunate indeed to escape with his life, it is a sheer miracle that Clark did not lose the use of his sculptor's hands, cruelly bound as they were for 36 hours in that frigid temperature. But today they bear no mark of this ordeal to which he was subjected by the emotional stupidities of these Mongols. Released, at last, when the irresponsible guerrillas came to their senses, Clark and Morden proceeded on to the safety of their homes in America.

Doctor Clark takes such jeopardous episodes philosophically enough, dismissing them as occupational liabilities. If one joins the army, he must be prepared to risk his life. The same goes for exploring.

The attitude is consistent throughout James Lippitt Clark's entire career. For he has vindicated as have few other men the wisdom of the adage that nothing ventured will result in nothing gained. His mechanical bent together with the flair for art were evident even in early childhood, but it was the courage to take chances, coupled with a canny New England shrewdness that brought him to the top of his profession. He was peculiarly fitted by virtue of his gifts and his temperament to carry out the work of Carl Akeley after that great man's death. The precision and beauty which characterized the execution of the African and all the other new halls in the Museum eloquently assert his claim to lasting fame.

LETTERS

Continued from page 60

soever. Not so with the copperhead,—which left us marveling at their discrimination.

Mrs. John Schlenker.

Northford, Conn.

* * *

Sirs:

I have been getting Natural History Magazine since last Christmas and am enjoying it more than any other magazine I read. Maybe you would be interested in the photograph I am enclosing of an opossum . . .

I would be very glad to see this picture appear in Natural History. It is one of the first I ever made with the Baby Brownie which I got for my eleventh birthday in June.

Christopher A. Fried.

Newark, N. J.

Sirs:

. . . This magazine has proved very interesting and reaches a great many people. Its final days are spent in our public school library where numbers of students read it from cover to cover.

It has improved greatly from the time I received the first copy, and I know its progress will continue.

Congratulations for offering the public such a fine magazine at such a reasonable cost.

James Haslam.

Palmerton, Pa.

• • •

Sirs:

Enclosed please find a money order to cover two Associate Memberships.

This is one of the things I am always happy to pay, believe it or not, for I have spent many happy hours among your great collections and used any amount of the material in my teaching. Most of my students who have had the good luck to get there have come away thrilled and inspired to go out into far places, to see things first hand for themselves and maybe one day to add their bit to the knowledge of the world.

. . . [She] is just a senior in high school but enjoys the Magazine more than any other that comes to their home. In fact all four youngsters, ranging in age from thirteen to seventeen, fairly fight to get an evening with its pages. So I thank you for the privileges of the Museum and hope you may have a greatly increased membership to carry along during this educational depression. . . .

(Miss) C. W. B. Chase,
Associate Prof. of Botany.

Wayne University,
Detroit, Mich.

* * *

Sirs:

We will appreciate brief mention in a future issue that Mr. Baker in using the title, "Deputy Game Warden, State of Arizona," did not reflect in any way the policies of this Department.

K. C. Kartchner,
State Game Warden.

Arizona Game and Fish Commission,
Phoenix, Ariz.

Needless to say, when Natural History Magazine published "Why Pick on the Predators," it was not the expectation of the scientific examiners who judged the article in manuscript that it would necessarily reflect the policies of any particular state. The problem involves questions on which honest men may honestly differ, and at the same time it merits the thought of every citizen interested in the country's wildlife.—ED.

DINOSAUR CHART

Through a last minute slip, the dinosaur chart in the December issue was printed with the following two labels transposed:

**WITH BIRD-LIKE
HIPBONES—Ornithischia**

**WITH "LIZARD-LIKE"
HIPBONES—Saurischia**

It is suggested that the readers cut out these labels and paste them over the ones on the chart in their proper positions. In the interests of scientific accuracy, Natural History Magazine will send without charge a fresh copy of the chart with the correction made to any subscriber sending his name and address.

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BIG PICTURES FROM LITTLE THINGS

Continued from page 58

extremely valuable for illustrating reports of investigations, whether popular or technical. Small objects under study are enlarged enough to make clear the description embodied in the text. In this issue of NATURAL HISTORY a whole series of photomacrographs reveal the process by which the insect known as a froghopper builds its bubble nest (page 54). Another example of photomacrography was published in last month's NATURAL HISTORY under the title "The Private Life of a Wasp." Magnification greatly increased the interest and value of these vignettes of waspish domesticity.

Until you try some photomacrography with your own equipment you won't be able to realize the thrill that comes with discovering unexpected beauty hidden in ordinary objects. Almost everything photographed under magnification takes on a new and unusual appearance.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Winter, 1942.

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This Wonderful World. Quiz program, with young people answering questions on nature subjects.

•

WEDNESDAYS over the Columbia Broadcasting System Network from 9:15 to 9:45 A. M. (Central Time: 2:30 to 2:55 P. M.; Mountain Time: 9:30 to 10:00 A. M.; Pacific Time: 1:30 to 2:00 P. M.)

Lands of New World Neighbors. (New Horizons: C.B.S. School of the Air.) The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

•

FRIDAYS over the Columbia Broadcasting System Network from 3:45 to 3:55 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.

Answers to Questions on page 61

1. Tin is the strategic metal least procurable in the United States. See page 24
2. False. Observations indicate that the skunk dislikes the evil-smelling ingredient mercaptan as much as any other animal does. See page 29
3. False. Skunks of both sexes are able to carry out an odor attack. See page 26
4. A tiglon, as everyone should know, is a hybrid feline a cross between a tiger and a lion. See page 53
5. The spotted skunk walks on its hands when it meets a dog. See page 28
6. Copra is dried coconut meat. See page 49
7. False. The ermine has a defensive odor thought by some to be more unpleasant than that of a skunk. See page 29
8. The Devil's Highroad connects two points in Arizona. See page 4
9. A skunk's ammunition is a volatile liquid. See page 28
10. Manila rope. See page 47

DO NOT MISS

THE SMARTNESS OF THE SMART COYOTE. "Next to God," the Mexican country people say, "the coyote is the most astute animal on earth." And for sheer "foxiness," others aver, he is several laps ahead of the fox himself. Drawing on facts and folklore, J. Frank Dobie supports these contentions with a wealth of sometimes breath-taking and always highly entertaining information, woven into an article that commands new respect for a much maligned creature.

•

Roots, like faith, can move mountains. They can also climb them or bind them together. They secure food for the parent plant and supply your table with some of its most succulent vegetables. Their most important part is the tip, but where this "nose" will lead—whether into the air, along the ground, or delving deep in the earth—is a matter of adaptation. In **GETTING DOWN TO THE ROOTS,** Henricks Hodge has written perhaps his most arresting article for NATURAL HISTORY Magazine.

•

Bird-fancier and avid shore-stroller alike will take delight in William Graf's splendid photographs of **CALIFORNIA MURRES,** depicting their life and antics on one of the precarious cliffs where they make their home.

•

Our war-torn world is "map conscious" now as never before, yet few of us realize how recent a thing the accurate modern map is. In **THE STORY OF OUR MAP,** Irene Cypher will review the part that maps played in the epic of America, from Columbus' time to the present.

•

After the dinosaurs, what? In forthcoming issues, paleontologists GEORGE GAYLORD SIMPSON and EDWIN H. COLBERT will round out NATURAL HISTORY Magazine's panoramic series of articles on the history of animal life in North America. The next installment will tell how, after an age in which monsters of great size and strength achieved world domination, the meek inherited the earth.

February **NATURAL HISTORY** *1942*

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LETTERS

SIRS:

I have just finished reading for the second time, "Don't Skin Your Skunk," by M. R. and C. M. Bogert. This is the most interesting and informative article I ever read on skunks. It is well written and also supplies information about these little animals that I did not know although I had already studied them somewhat.

Perhaps Mr. Bogert would be interested to know that I have seen the little spotted skunk do the handstand for me instead of a dog, not only in the woods but in captivity. I once had a pet spotted skunk, and friends thought I had it trained to do the handstand, because all I had to do was to tap the wire on his cage and he would stand up on his front feet, much to the amazement and pleasure of friends and visitors. He never failed to do it, dozens of times each day.

We all admired the beautiful picture on the cover of the January NATURAL HISTORY.

ROSS ALLEN.

Ocala, Fla.

* * *

SIRS:

Your recent articles of evolution were of the utmost interest to me. I hope you continue to publish many more similar ones.

WITMER S. HUNT.

Forest Park, Ill.

* * *

SIRS:

. . . We surely look forward eagerly to your magazine in our Biology Department and class it above all others of its kind which we take here. Best wishes—always!

H. THEODORE STUBBS.

Weehawken, N. J.

* * *

SIRS:

. . . I enjoy your articles on paleontology very much. Lets have more of them.

LELAND SMITH, JR.

San Antonio, Tex.

* * *

SIRS:

I want to let you know how much we are enjoying NATURAL HISTORY, and how our children look forward to it each month. My parents, brothers and sisters, and their children have long been great admirers of your magazine, and especially of its new attractiveness and interest during the past few years. All the articles are fascinating and instructive. Among the many articles which I have enjoyed are the two by Doctor Gudger on "dogs which fish" and on "the smallest fish." I hope he will write others from his great store of knowledge in his field.

With gratitude for the privilege of sharing in the educational advantages of the Museum. . . .

CHARLES A. PERERA, M.D.

Scarsdale, N. Y.

* * *

SIRS:

Although I have not been a subscriber very long I enjoy every copy and look forward to the next.

I especially like the articles on extinct animals. Your "Dinosaur Family Tree" was good. . . .

NICK HARMON.

Harriman, Tenn.

* * *

SIRS:

I had seriously thought of giving up NATURAL HISTORY this year . . . but I shall miss it dreadfully if I do, so here goes for one more year at least, and no doubt many more.

It seems to me once you have taken NATURAL HISTORY you can't give it up even though you think you can.

MRS. MABEL A. THORNTON.

Vineland, N. J.

* * *

SIRS:

. . . Your magazine is marvelous—it is instructive, entertaining, and beautiful, and I look forward eagerly to its coming every month. I am proud to be a member of your wonderful organization.

(MRS. GEORGE W., JR.) GRACE F. H. HEAD.

Dover, N. H.

* * *

SIRS:

I have just finished reading my second issue of NATURAL HISTORY. Of all the magazines to which I subscribe, it is the most fascinatingly appealing. In my work as a teacher of biology, I find it immensely valuable, and in my hobby of photography it furnishes an inspiration and a goal toward which to strive.

R. D. MIERSWA.

Sheboygan Falls, Wis.

* * *

SIRS:

It pleases me to say that we have never had a more beautiful or more informative magazine in our home than NATURAL HISTORY, and I want to thank you for the great pleasure it gives us.

(MRS. ERNEST) MARY ROBINSON.

Kansas City, Mo.

Continued on page 67

NOTICE

Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

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Above illustration Nile River Group Detail showing Antelope Akeley African Hall American Museum of Natural History

CARRION PLANT

By Jewell Casey

"To him who in the love of nature holds communion with her invisible forms she speaks a various language," according to the poet Bryant, and so it is. The true lover of nature appreciates all forms of plant life, even the flowers of the so-called "rotten egg" or "carrion plant," although from these blossoms emanates an odor strongly suggestive of decayed meat!

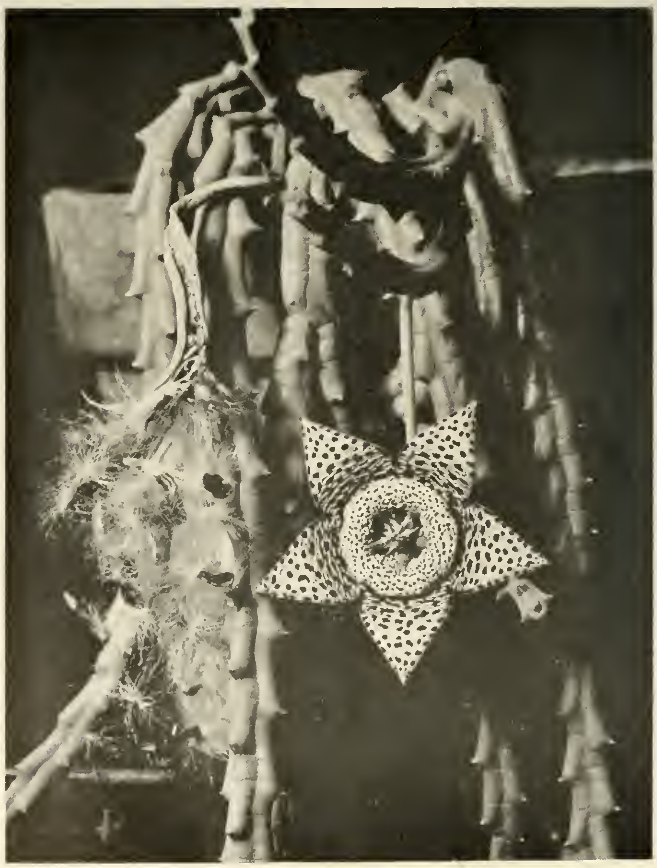
These carrion plants *(Stapelia variegata),* while native to southern Africa, have found their way to America and except during the flowering season are usually regarded as interesting, inoffensive trailing pot plants.

The blossom, about two inches across, is a rich cream color, lavishly decorated with splashes of chocolate brown, and has five petals which surround a "cup" in the center. Opening in early morning and closing with the setting of the sun for a period of three days, the blossoms attract green flies and other carrion loving insects.

After the third day the flower closes tightly and within a few days drops off, leaving the flowering stem with a formation which resembles the bud before opening.

For the next ten months the flowering stem and the formation on the end remain the same,—and then there is a perceptible change. The "bud" begins to grow, lengthening and thickening until there is a pod about four inches long and as thick as one's little finger. Within a month the growth is completed, and then another month passes before the pod turns yellow and splits down the center. Thereupon flat, brown seeds, which have silken hairs very much like those of milkweed seeds, emerge to be picked up and carried away by the wind.

Although somewhat similar in habit of growth and general appearance, the carrion plant is not closely related to the Rafflesia, native of the East Indies, which produces the largest flowers in the world —blossoms said to weigh from ten to fifteen pounds each and attain a width of three feet, with the cup inside the petals capable of easily holding two gallons of liquid.



LETTERS

Continued from page 65

SIRS:

The accompanying photographs are two views of an unusual curiosity which I found while walking near the edge of the Helderberg escarpment near Altamont, N. Y. The first picture shows one fully formed ring of snow, and the second picture, taken only a short distance away, shows two others, one of which appears to have partially melted in the sun.

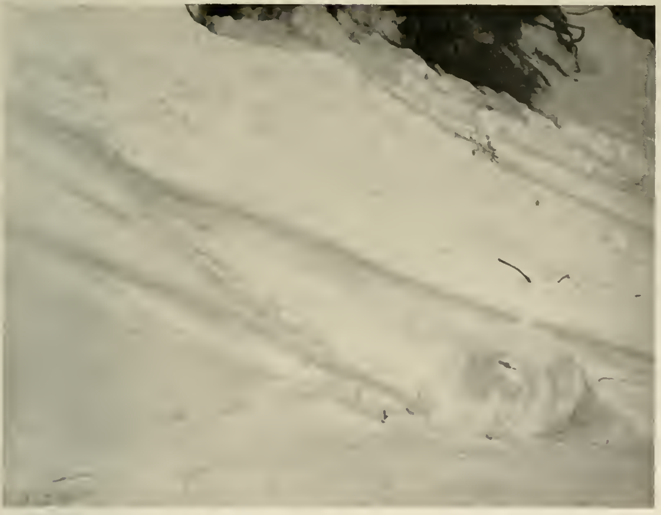
I have not yet been able to find anyone who can explain their formation. Apparently, the rings are formed in a manner similar to that in which natural snowballs are formed—by wet snow rolling down an embankment—and from the photographs it can be seen that all of the rings are at the bottom of a fairly steep slope. Doctor Zahl has suggested that possibly the rings occurred when a snowball of the type described above formed about a stone, the warm spring sun later melting the snow to such an extent that the stone sank through the snow to the ground below. My own theory is that the snow became crusty through alternate freezing and thawing, that the crust sprang outward at the top of the slope, and that the next warm spell softened it to such an extent that it commenced to roll down the hill in the manner of a hoop. The path which the ring followed and the lines of its formation can clearly be seen in the first photograph.

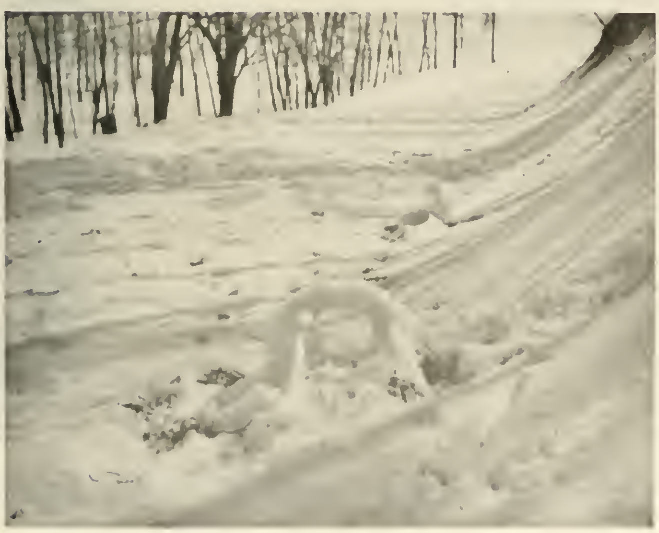
DUANE FEATHERSTONHAUGH.
Schenectady, N. Y.

* * *

NATURAL HISTORY regrets that in spite of diligent inquiry no further explanation of this curious phenomenon has been found.—ED.

Continued on page 128





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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President | WAYNE MOODY FAUNCE, Acting Director

VOLUME XLIX—No. 2 ★ ★ ★ ★ ★ ★ FEBRUARY, 1942

A Living Cock of the Rock........Cover Design

Photographed by Lilo Hess, Courtesy of the New York Zoological Society

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You will find NATURAL HISTORY Magazine indexed in *Readers' Guide to Periodical Literature* in your library

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ART AND PRODUCTION: Frederick L. Hahn.

ASSOCIATE EDITOR: D. R. Barton, A.B.

ASSISTANT EDITOR: Ruth Gannett, B.S.

EDITORIAL ASSISTANT: Katharine Lahee, M.A.

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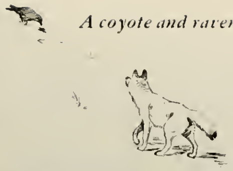


A coyote and raven at play

Drawings by O. J. Murie,
Courtesy National Park Service

Just tracks!

(Below) A group in the American Museum. At a distance the coyote may be mistaken for a tawny shepherd dog. Normally it is much less to be feared than the average stray dog

AMNH photo

Tantalizing

All in a beap

That raven!

THE SMART COYOTE

Tricks almost unbelievably clever win a unique reputation for the animal whose voice is symbolic of our wild open West

By J. FRANK DOBIE

"NEXT to God," the Mexican country people say, "the coyote is the most astute animal on earth." Rangemen will sometimes admit that he is as smart as a cutting horse,—and a cutting horse can "do everything but talk Mexican." He's at times even smarter than a steel trap, some trappers have conceded. He is so smart that centuries and centuries before the history of the native peoples of North America began to be recorded he had burned himself upon their imaginations and come to be both hero and clown of more tales than all the other animals of the continent combined have inspired.

The trouble—from the standpoint of the scientific mind—is that evidence of the coyote's smartness so often edges off into pure folklore. I have been a long time taking down evidence from many witnesses and sifting it. I am going to start out with cold facts; if I run into the yarns, I'll make a sign and swear that I don't know whether I am telling the truth or not.

Like the rattlesnake and the droll little burrowing owl, the coyote will be associated with prairie dogs as long as a prairie dog is left in coyote country. The coyote is very fond of prairie dog meat, and the prairie dogs, always on guard—except when they are safe in their underground forts—and always alarming each other at the faintest suggestion of danger, are probably the most difficult of all small animals for beasts of prey to catch. But—

> There are nine and sixty ways of constructing
> tribal ways
> And every single one of them is right

Really smart people are various in their ingenuity.

One of the best observers and the most richly informed homemade naturalist I have ever known was Don Alberto Guajardo, whose many years of ranching, soldiering, surveying, mining, hunting and gathering of medicinal plants for exportation had taken him over most of northern Mexico. He compiled history from ancient documents, read Latin and spoke two other languages besides his native Spanish, but he always asserted that the best contributor to his education had been an old Lipan Indian.

One time during his boyhood, he told me, he went out hunting with this Lipan. This was back in the days when Apaches and Comanches still raided, and, suspecting danger, the old Indian and the boy hid in brush overlooking a valley well populated by prairie dogs. The sky was dark and threatening rain. Before long the boy saw a coyote come out among the prairie dogs on the edge of the "town," close to the base of the big hill on which the two hunters were hidden. The coyote was not aware of them. He went to scratching, scratching at a doghole into which his approach had sent the owner, followed by neighbors into their respective holes.

"Surely," said Don Alberto to the old Lipan Indian, "that coyote does not think he can dig down to the bottom of a prairie dog hole."

"No, no," replied the old one. "He knows what he is doing. Wait with patience and you shall see."

By now thunder was rolling up, and the coyote was digging more energetically. This animal seems always to feel the approach of changing weather. The plan of the digger began to be apparent. He was merely pulling down the crater like, encircling mounds of two or three prairie dog holes and using the dirt to throw up a rough V shaped dam, the flanges pointing uphill, so that they would catch the water as it flowed down, thus directing it into the now unprotected holes enclosed by the V.

Presently the heavens turned loose. The rain was a regular gully-washer and fence-lifter. The water scooted down the hillsides in sheets. That caught by the coyote's dam poured into the holes. Meantime the coyote had placed himself back of the dam, at its apex, where he awaited results. The typical prairie dog hole has a roomy side-tunnel, or station, not far from its mouth, where the owner, with his family, can remain clear of the water at the bottom of his burrow. Sometimes the burrows are connected. Water will not reach the prairie dog and his store of food until the hole is filled from the bottom. Many a boy has failed to drown out a prairie dog by pouring buckets of water after him. But here a stream of water was being diverted into the holes. Before long the watching Indian and Mexican boy on the hillside saw a prairie dog emerge, only to be nabbed by the ingenious coyote.

Not long ago I spent a day and a night with H. C. (Pete) Gamison at his cabin overlooking Eagle Nest Lake in northern New Mexico. For nearly 50 years he has been hunting, poisoning, trapping lobo wolves and coyotes. He has enough education to give perspective to his natural intelligence and observations. Not many men alive know at first hand as much about the wolf family as he knows.

One time, he told me, he watched a pair of hungry coyotes out to catch a prairie dog. They tracked leisurely along, one right behind the other, towards the edge of a prairie dog town. Presently there was a great chattering at them. But the prairie dog they were headed for could see only the lead coyote, the one behind keeping his head down and his body hidden by that of the first. When near the mound on which the prairie dog stood nervously scolding, the lead coyote made a rush, and, of course, the prairie dog ducked. The sun was shining from a clear sky, and when the coyote leaped over the hole he darkened it with his shadow. He went on, other prairie dogs chattering and ducking, the noise growing dimmer as he passed.

But the second coyote had stopped when the first one leaped, and while the play was going on, he flattened himself out as flat as he could behind the dog mound. There he waited until the prairie dog should come up. Before long he reappeared, looking with intentness towards the enemy that had threatened and passed, but was still in sight. It is the nature of a prairie dog to look for what has scared him. While this one was indulging his nature, expressing his displeasure at the same time, the accomplice of the first actor made a leap and caught him. Then there was a tussle over the morsel, the two coyotes soon tearing it to pieces and devouring it.

By coincidence, three or four days after Pete Gamison had enriched me with his coyote lore, I paid a visit to the veteran naturalist and teller of animal tales, Ernest Thompson Seton, at Seton Village, near Santa Fe. After hearing talk on wolf sagacity, I came away with a copy of Mr. Seton's recently published autobiography, *Trail of An Artist-Naturalist*. A few hours later, I read this passage:

> One coyote crouched behind a thick greasewood; the other walked openly toward a prairie dog that was yapping on its mound. He made a half-hearted rush as the prairie dog dived. The coyote far back behind the greasebush now rushed forward and crouched behind a bush that was only six feet from the prairie dog hole. Meanwhile Coyote No. 1 sauntered slowly forward. Presently the prairie dog peeped out. He saw that Coyote No. 1 was at a safe distance, and that he was going still farther away. The yapper became bold; he stepped right out and yapped at Coyote No. 1. Coyote No. 2 rushed forward and almost got him. In this case the trick failed, but obviously it must often be successful.

An old trail driver and cowman—J. H. Maltsberger, of Cotulla, Texas—not at all given to the fanciful tales he has often heard, told me that early one morning he saw a coyote closing up prairie dog holes in a certain part of a town. Later he got a prairie dog cut off from its own hole. Naturally it made for the next nearest hole—one that the coyote had with malice aforethought plugged. The hesitation at the closed door cost this prairie dog his life.

After bringing sheep and goats to America, the Spanish *conquistadores* soon came to recognize the coyote as the chief enemy of these small animals, though one encounters no record of its interfering with the spread of cattle and horses. The early Spanish historian Clavigero describes the coyote as using its tail as a whip. Having picked out a fat sheep and seized it by the neck, the coyote was said to lash its victim in the rump to urge it to a convenient place for eating. This cunningly fantastic way of leading a sheep to its own slaughter may be doubted by some naturalists, but many shepherd people both in Mexico and the United States aver that it is true. The coyote is not strong enough to move a carcass in the manner of the mountain lion, and so if he moves it at all, he must use his wits.

In the old days before coyotes had been killed off sheep ranges and before wolf-proof fences had been put up to keep them out, dogs were essential to every shepherd guarding his flock, especially at night. Then it was common for one or more coyotes to make a feint attack in the darkness on one side of a flock, drawing all the dogs after them; meanwhile other coyotes cut in from an unprotected direction, getting their meat in such a hurry that they would be gone before the guards reappeared.

It is the neck of a chicken, as with goats or sheep, that the coyote aims to seize. His hold on the neck is not invariable, but whereas a coon will seize a chicken by the leg or wing, making off while the chicken's squawk arouses dog or man, the coyote is likely to kill the chicken immediately by biting it through the neck or head. He is a noisy fellow, but he will not be heard barking or howling while on the hunt, and he seems to recognize the value of silence in his victim as well as in himself.

Dogs may learn better than to attack porcupines, but few which do attack achieve a strategy that will save their faces from being quilled. Nat Straw, famous hunter and trapper of New Mexico, told me that examination of the stomachs of dead coyotes had frequently revealed porcupine quills as well as flesh, though he never found quills in the coyote's head. He was puzzled until a forest ranger described seeing a coyote root a porcupine over, seize it in the breast, which is spineless, and in this fashion gain his entrance.

Of all predatory animals, wolves are undoubtedly the most co-operative. Coyotes go beyond timber wolves in co-operation, for they relay and otherwise assist each other not only in running down game but in eluding their own pursuers. A mother coyote whose not-yet-grown offspring is being run by a pack of hounds will actually, after running a while with the young one, turn back and make right through the dogs, trying to lead them off the trail. It takes a great deal of training to prevent most dogs from switching on such a trail.

For ways that are dark and tricks that are effectual, followers of hounds in the vast brush country of southwestern Texas will tell you that the coyote is several laps ahead of the fox. One summer night while I was out with a group of these brush country hunters, we heard the dogs running for hours in an area hardly two miles square. The dogs were having a wonderful time; they were giving us wonderful hope and expectation; and I believe that at least one coyote—maybe more than one—was having a wonderful time.

An hour or so before daylight a man named Wright dropped out of the race, saying that he was going to take a nap on a nice bed of mesquite grass he had spied close to a mesquite tree and that he would rejoin us when we came back his way. Upon our return after sunup he told how, at daybreak, he had heard the dogs making eager music fully a half mile off, seemingly coming his way, when two coyotes trotted into sight. One of them looked mighty hot and tuckered out; the other appeared to be entirely fresh. They did not sense him, apparently, and presently the tired coyote disappeared in a direction leading away from the hounds while the fresh one tore out in their direction. It is certain that the dogs did not run down a thing on that hunt.

Coyote teamwork after jack rabbits, antelopes and an occasional deer has been observed many times. It is the nature of these animals to circle when pursued. Coyotes will take stands—pretty much as mustang-hunters used to in running down the great-circling mustangs. As a fagged pursuer comes up behind the game, he is relieved and drops out for a rest until it is his turn to run again.

Riding one day over a divide in Montana with another rangeman, Malcolm S. Mackay, in *Cow Range and Hunting Trail,* tells how he noticed a coyote sitting on a hillside and intently watching something in the valley below. Looking in the same direction, the men soon saw another coyote coming behind a jack rabbit. After a circle that covered perhaps a mile, the rabbit passed near the waiting coyote, which now dashed in while the first coyote dropped out.

> Going downhill, the coyote would almost catch Mr. Jack Rabbit. He would have caught him if Mr. Jack had not done some real dodging. Going uphill, the long springy legs of Mr. Jack gave him a distinct advantage, but in that country there are as many valleys as there are hills, and so what the jack gained going up the coyotes gained going down. The race went on for three complete laps. Then, after having saved his bacon numerous times by flattened-out dodges, the jack quit circling and ran straight up a ridge toward a mountain. The last we saw of him he was doing well, with both coyotes far behind.

An old rangeman and hunter named George Bigford told me that he had seen as many as eight or ten coyotes round up a number of jack rabbits and keep circling them while one coyote would run in and catch himself a mouthful. At this the rabbits all scattered, coming out so thick, however, that nearly every coyote in the roundup caught one.

One winter while I was deer-hunting in the brush country, I tied my horse on a hill and began slowly walking along a dim trail that wound down a brushy draw. Before long I saw in a sparse opening ahead of me a coyote haunched down on the left-hand side of the trail. He was looking very intently, though in a manner altogether patient, to the right. I stopped to watch him. I did not wish to shoot him. For maybe two minutes he remained absolutely motionless; then he sensed me and disappeared.

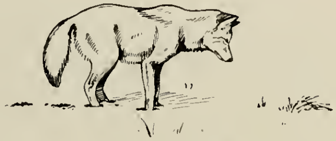
When I stepped to the spot he had occupied and looked where he had been looking, I saw a badger digging into an enormous rat's nest of cactus leaves and thorned sticks built in and around a clump of prickly pear. The badger is obtuse in his senses. This one was not in the least disturbed by my nearness. Directly he got down to the fur lining in the nest, and a big fat wood rat darted out, coming my way. Had I been a coyote, or had the displaced coyote been in his selected position, that rat would certainly have become a juicy morsel. A Mexican goat herder told me he had seen as many as three coyotes hanging around a badger, waiting for him to scare out wood rats. Of course, the badger sometimes catches a rat himself. A well established nest usually has more than one runway into it. A coyote can dig very well indeed in soft ground himself. He knows where he can dig in a sandy arroyo down to water, and he knows when to let the badger dig for him.

Perhaps there is a kind of understanding between the coyote and the badger. The Mexican name (Indian in origin) for badger is *talcoyote*—"like a coyote." Suggestive of the relation between the two animals, a pot that I have, 2000 years old perhaps, excavated from ruins in Mexico, shows a coyote head on one side and a badger head on the other. A badger has been observed following—as best he could, for he is not a swift runner—a coyote that chased a cottontail into a hole. The presumption is that the badger expected to dig the rabbit out, not for the coyote's benefit, however. The coyote sometimes gets a gopher excavated by a badger, just as he does a rat. If a female coyote can find no better place, she will den and pup in a badger hole.

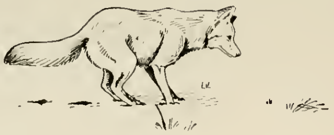
Mary Austin, who made many acute observations on the wildlife of the Southwest, says that the coyote watches crows and buzzards—"tracks in the sky," as the Indians call these birds—for guidance to carrion. The coyote that will touch a carcass left by a mountain lion, no matter how many signs point to it, is the exception, however. He is afraid of the mountain lion, which occasionally eats coyote flesh.

Over and over, in ways endlessly various, the coyote has proved himself extraordinarily adept at taking advantage of the situation. If he can't get meat one way, he'll get it another. If he can't get meat at all, he'll thrive on berries, acorns, watermelons, any vegetable food that any other animal eats. He can fish like a coon. He is as omnivorous as human beings or hogs. No other creature of the wild has so well adapted itself to the changes wrought by encroaching civilization. Chased off of sheep-grazed and chicken-pecked plains, he is now found in high mountains, away up on the Yukon River, far east of the Mississippi River—places that a generation ago were unknown to the species.

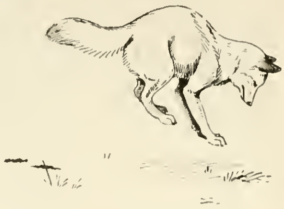
Truly, he lives by his wits. May his shadow never grow less!



Something stirring!



A mouse?



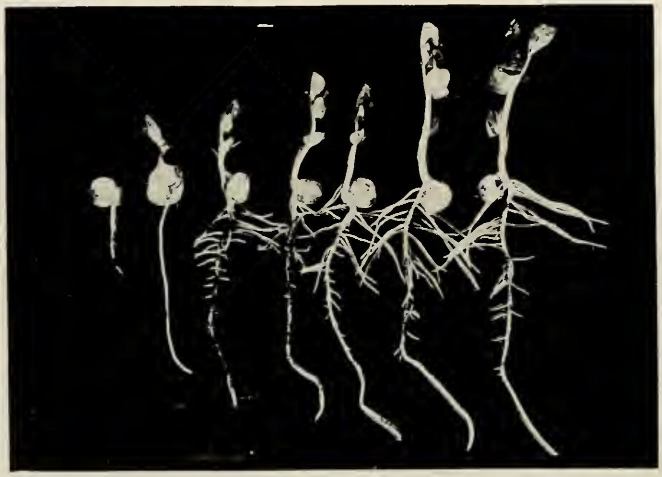
The pounce

Drawings by O. J. Murie, Courtesy National Park Service

THE COYOTE has remarkable ability to adapt himself to a new situation. He therefore finds it less necessary to retreat before man's advance

(Bottom circle) A YOUNG COYOTE. Five to seven are generally born in one litter. The den is usually a hole in a bank or among rocks

Hugh S. Davis photos



Sprouting pea seedlings make their critical all-out dive for moisture and dissolved minerals. Unless they get both, death is certain

Ge

R

ng down to the
OOTS

Roots, like faith, can move mountains. They can also climb them or bind them together. Though a single root system can penetrate miles of soil, its most important part is the first quarter-inch. But where this "nose" will lead—whether into the air, along the ground, or delving deep in the earth—depends on the often astonishing individuality of the plant

By HENRICKS HODGE

ALL PHOTOGRAPHS BY THE AUTHOR, UNLESS OTHERWISE CREDITED

MOST roots are reticent things. Even the first young root of the sprouting seed pushes out furtively and dives to spend a mole's life beneath the ground. The result of this habit is that we know considerable about all other plant organs—leaves, stems, and flowers—, but our knowledge of roots is comparatively small.

To be sure, anyone who has ever tried to dig up even a small tree knows what a tough job it can be and how strongly the roots attempt to fulfill one of their principal functions—to support the tree. And again, when one's Oriental poppies die after transplanting, the importance of roots in a plant's life is only too strongly brought to mind.

Primitive peoples probably knew more about the kinds of roots than do their civilized descendants. This is to be expected, for in early times the ability to recognize this or that kind of root went a long way towards solving problems of meals and medicine. Certain early Greek physicians derived their title from these subterranean plant organs: they were the "root-cutters," the rhizotomi. These folk believed that all the healing properties of plants were limited to the roots. Today we see the hang-over of such early beliefs in the common names of many familiar plants, such as: bloodroot, cancerroot, and snakeroot.

Roots still influence the life of man to no small degree and form important portions of his diet in most parts of the world. Just go down to the corner market and look at the familiar beets, carrots, turnips, radishes, parsnips, and sweet potatoes, and you will realize what a meal would be without roots. In the tropics yams, cassava, and countless other root vegetables play a still greater part in the daily diet. All these cultivated roots have been developed from wild ancestors and in some cases have become so changed that their origin would hardly be suspected. The wild carrot, for instance, commonly known as Queen Anne's lace, is the direct ancestor of our cultivated garden carrot, yet its root in the wild form is generally small and stringy. Some roots find their way into the arts and crafts, yielding valuable dyes and materials for basketry.

Modern plants show many different types of roots, but their distant ancestors did not. A period existed, far in the past, when no plants had roots. Indeed, there was no need for them when all life was aquatic. Those were the days when the stuffs from which plants manufactured food could filter from the water into any portion of a submerged plant's body. And those were also the days when the lowliest of plants —the algae—were the rulers of the world. Even today if you want to see plants totally undifferentiated into organs of any kind, examine the simpler algae. Some of them, like the rockweeds and giant kelps of our coastal waters, have "holdfasts" which certainly mimic roots, but the similarity is superficial and ends right there. In construction and purpose these nonassimilating, fastening organs are

U. S. Forest Service photo by B. W. Muir

UP AND DOWN. *(Left)* These knobby growths are "knees" of cypress trees, through which the submerged roots breathe. *(Right)* Anchors as well as feeders, roots delve deep, losing their strong grip only under such force as the hurricane blast which felled these trees still far removed from real, honest-to-goodness roots.

But evolutionary progress on dry land required roots both for support and as a means of tying and cementing vegetation to its prime source of raw materials, the earth.

Of course you have seen a seed germinate. The very first thing to pop out is not stem, not leaf, not flower, but root. No matter what is the position of the planted seed, down goes the root, answering the gravitational urge just as surely as Sir Isaac Newton's apple. The snaky youngster almost seems to know what it's after. It is seeking, above all, moisture, and the mineral salts dissolved in moisture. Unless it gets both of them fast, it will fail to make a success of life. A ticklish period, germination—a period when the success of an infant root marks the line between the life and death of the plant.

The most important part of any root is its tip. This is the portion we seldom see, for when a plant is yanked out of the ground most of the finer roots with the tiny tender tips are broken off. It is in the tip—the first quarter-inch of a root's length—that all its powers are located, for if one slices off this segment the root is helpless. The tip is the center of growth—of elongation. Here are located the root's "nose" and "sense of touch," which enable it to turn towards the greatest moisture, the best food, the most favorable temperature, or on the other hand, to avoid toxic substances and to creep around physical impediments. Such a control center ought certainly to be well protected, and it is. Creeping onward in subterranean growth, root-tips are forever running against the abrasive action of soil particles. They would soon be worn completely away were it not for the thimble-like cap or calyptra protecting them. New layers are continually added from within to replace all outside wear and tear. The root-caps of most plants are tiny--hardly visible to the naked eye—, but on aerial roots of certain large tropical species you will be surprised to find them prominent and easy to examine.

Back from the root-tip one meets the older portion of the root, just as in the aerial skeleton of a plant the trunk is older than the twigs. Like the trunk and branches, roots of shrubs and trees grow thicker with age and lay down a corky bark. Roots don't have to be big to be strong, and when they meet soil obstructions they frequently perform miracles, splitting boulders and causing sidewalks and pavings to careen. There is a case on record where the root of a birch tree entered a rocky crevice and in the interval lifted a boulder weighing 20 tons. This feat flattened out the root into a ribbon, but it at least made some room for itself.

As far as water is concerned plants are the heaviest drinkers this world has ever known! Most of this liquid passes off through the leaves into the atmosphere but all of it has to be absorbed by the roots. It has been shown that in hot summer weather a single birch tree with 200,000 leaves gives off 700 to 900 gallons of water a day, and most plants give off a daily quantity of water equal to their own weight. You can see what a task roots have, to supply such tremendous quantities of water, and all of it comes from the soil. No wonder lawns and gardens become dried out when rain fails to come.

Roots are efficient. In order to get plenty of water-absorbing surface many of the cells close to the growing root-tip push out to form root-hairs. These act as a pumping system, sucking up all available moisture and relaying it to stems and leaves. Unfortunately the task of the root is not as easy as it sounds; for if moisture in the ground is not abundant, the root-hairs have to fight with the soil particles for what is available. But when water is finally absorbed it goes into the root proper and thence upward to the leaves via the plant's woody cylinder.

Root systems are long,—longer than most people realize, for this underground ramification is always larger than the part of the plant growing above ground. If it doesn't look so when a garden weed is pulled up, it is only because all the finer rootlets have been broken off. The root system of a single oat plant, though occupying but a cubic yard of soil, was found to measure well over 450 feet in length. At that rate the roots of a giant sequoia would have to be measured in miles!

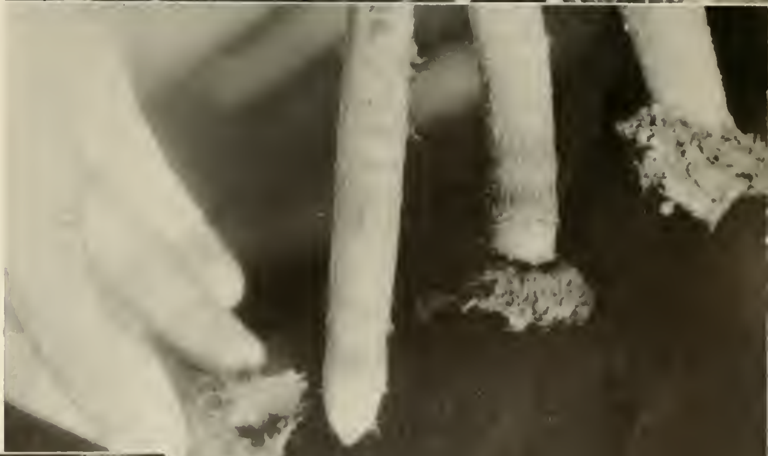
Normal roots, the familiar underground type, take two forms. The many fine roots of grasses are known as fibrous roots. But many plants put all their faith in a single large organ or taproot, like that of a parsnip, which has but few laterals. Most taproots, particularly those of the common root vegetables, not only take in water and raw materials but have also expanded their facilities so that they may serve as storehouses for food. Certain of these plants can boast of roots that reach an enormous size, such as those of the "man-of-the-earth" *(Ipomoea leptophylla)* of the Western Plains. This bushy relative of the sweet potato, with an erect stem only two to four feet tall, has a taproot that often attains a weight of 100 pounds. Such a reservoir of food and water enables the "man-of-the-earth" to thrive in a region where rains may be extremely limited.

The normal life-span of any plant is directly related to the life-span of its roots. So-called annuals have roots whose duration is but a year; whereas perennials can live almost indefinitely. In between these two are the biennials—plants like the carrot—which live for only two years. Length of life of the

PLANTS did not always have roots. There was no need for them hundreds of millions of years ago when all life was aquatic. At left is the holdfast of a giant kelp. This crude mimic of the full-fledged root is purely an anchor and has none of the nutritional functions so important in land roots

THE TIP is the business end. It is the center of a root's growth, the "nose" and "sense of touch" which enable it to dodge impediments and find the best food

TO PREVENT wear and tear of abrading soil on these vital probes, Nature has equipped them with special protective caps called calyptra. In the picture at right one of these thimble-like devices is being removed, exposing the sensitive tissue beneath

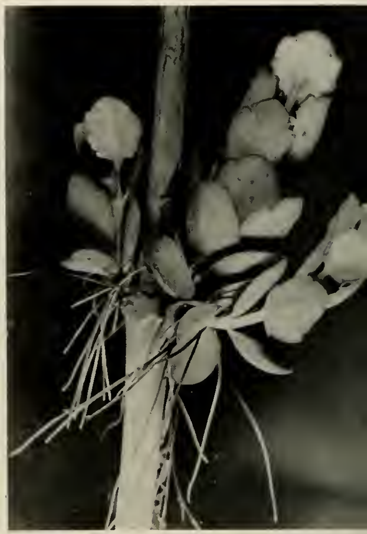


(Left) AN "UNDERGROUND" view of a root system. These labyrinths of fiber belong to corn plants growing in nutrient solution. Fibrous root systems are amazingly long. That of a single oat plant which occupied a cubic yard was found to measure well over 450 feet in length

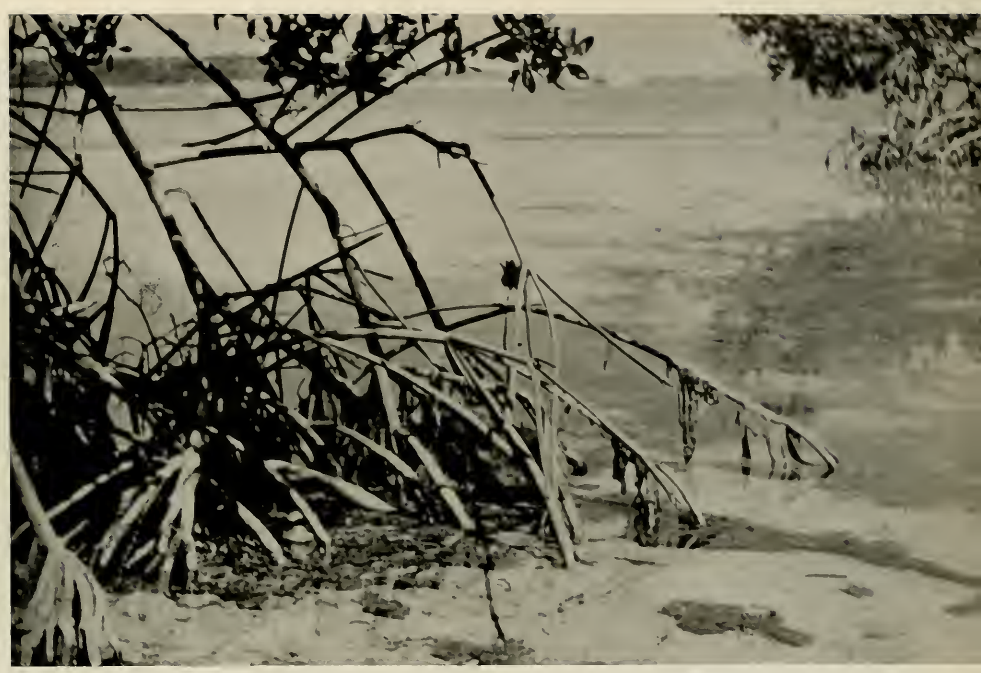
(Above) FOR stabilizing wind-blown dunes, nothing is better than a grass. This fibrous-rooted family has the ability to tie soil together, thus playing a great role in land reclamation and conservation

OTHERWISE TOP-HEAVY, the pandanus plant sends out prop roots from the main stem which are able to support it. So zealously do the prop roots perform their function that at maturity the main trunk has died away, leaving no other support

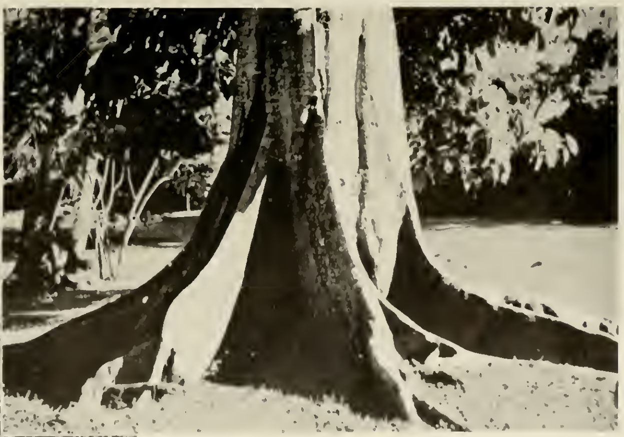
(Right) SHOOTING down into the ground at an angle, the innumerable prop roots of the palm *Euterpe* strengthen it against the winds that freely buffet its head about



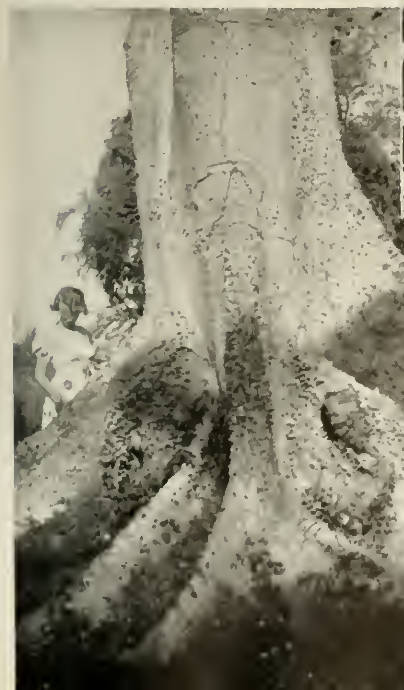
(Above) A "LIVE-FOREVER." This
zarre plant *(Bryopbyllum crenatu*
actually originates plantlets, compl
with roots and leaves, high up on
aerial portions of the parent. Here i
spectacular example of adventitious r
formation which enables plants to
produce without flowering, a meth
employed by many of our pernici
weeds



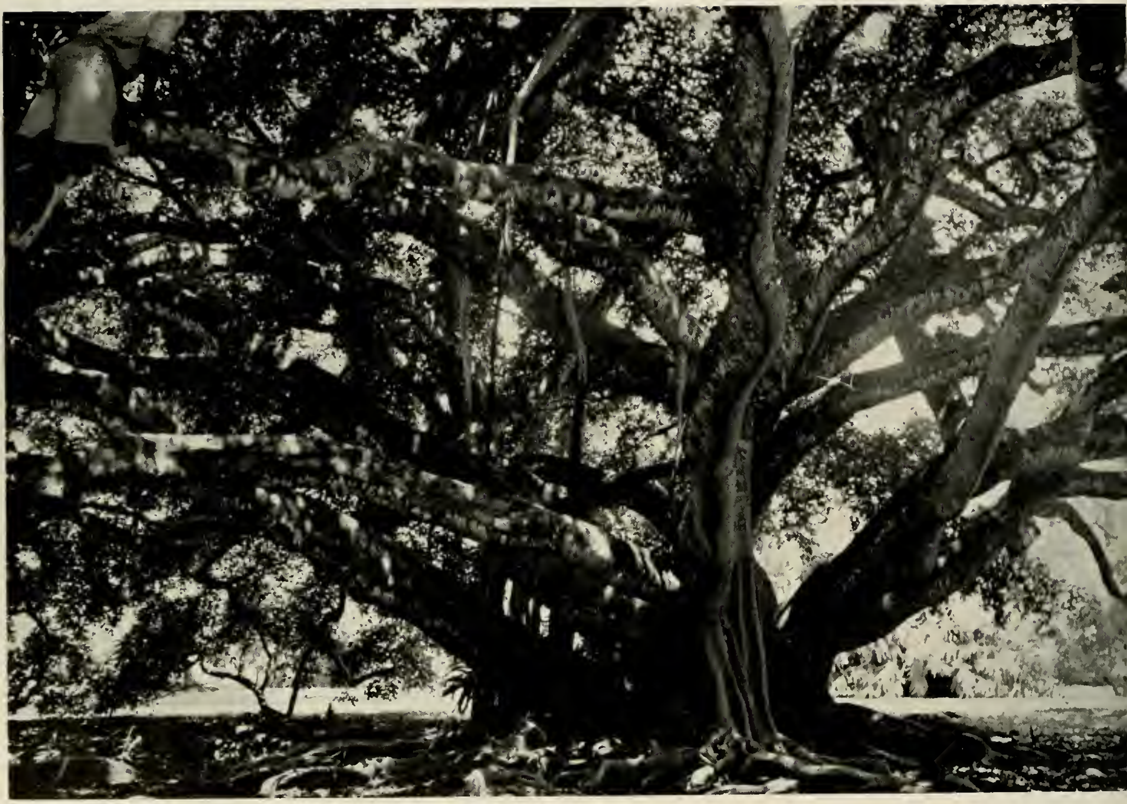
MOST FAMOUS of all prop-rooted plants are the widespread mangroves *(above)*, builders of the Florida Keys. On a multitude of interlacing stilt-roots, the mangroves wade out through shallow water. The tangled roots gather all the tidal litter and thus build up land where once was water



FLYING BUTTRESSES support the main columns of Nature's forest temples much as they are used in the Gothic cathedrals of the Old World. The tree above is the giant tropical species, *Sterculia*



THE SILK-COTTON tree of the West Indies likewise boasts a set of buttress-like ridges which can see it through many a hurricane season. This is the tree which in its cultivated state yields the fiber known as kapok. It has large pods filled with cotton-invested seeds



1

root is evidently controlled somewhat by climate, for the castor bean is perennial in its native tropics, but acts as an annual in temperate regions. Wheat that is planted in the fall (winter wheat) acts like a biennial, but always as an annual when it is planted in the spring (spring wheat).

Agriculture capitalizes on root structure, and growers who own dry farmlands well know that certain crops like alfalfa, because of deep roots, can exist where others would fail. On the other hand, tap-rooted plants are useless on loose soils which, always susceptible to erosion, need tying down. On such soils the fibrous root is the answer. Thus for stabilizing wind-blown dunes nothing is better than a grass, as you can see on any sandy seacoast.

Variety in roots is endless, especially in the group called "adventitious." The thing we think of first about roots is that they live underground, but there are many which have the strange habit of originating on leaves or stems. On these adventitious roots is based the whole foundation of plant propagation by means of layering and cutting. In this way the housewife "slips" a new geranium or begonia and thus short-cuts Nature. Actually she is merely copying Nature, which has long followed such practices. Many a shrub—forsythia, raspberry, or blackberry—arches its branches in such a way as to permit rooting at the tips. Similarly strawberries send out rooting runners, and the walking fern anchors its frond tips

2

in terra firma. Certain bizarre plants, such as live-forevers *(Bryophyllum)*, actually form plantlets, complete with roots and leaves, suspended on the aerial portions of the parent. This type of adventitious root-formation, of course, supplements seed production by enabling plants to reproduce without flowering, and many a pernicious weed is such because of this free rooting behavior.

Not all abnormal roots are for reproduction, however. Native Indian corn, though husky enough above ground, is invariably top-heavy, being supplied with a rather weak main root system. But Nature comes to its aid by early sending out peculiar roots as props. Palms, screw pines *(Pandanus)*, and many another tropical plant with a heavy crown that is freely tossed about by the wind, have to develop so-called "prop roots" of this sort as stabilizers or shock absorbers. Such roots commonly spring out from the stem above the ground and then penetrate the surrounding soil, burying themselves at a 45-degree angle. Special fibrous tissue is developed in prop roots, and this is arranged in such a way as to resist powerful strains caused by the wind. At the same time the tissue is so highly elastic that in any kind of breeze its spring-like, supple resilience is sufficient to force back the bending plant into its correct vertical position. Prop roots are more common in the tropics, especially in regions where very wet soils make normal roots precarious.

At maturity plants like pandanus have, indeed, nothing but prop roots, the main trunk having died away. Most famous of all prop-rooted plants are the widespread mangroves *(Rhizophora)*, which have the habit of sending out multitudes of freely branching stilt-roots. The formation of these is so rapid that the mangrove trees might almost be said to walk through the shallows upon their interlacing stilts, which hold in their grasp all the litter of the tidal flats. Land inundated by shallow seas is thus reclaimed. In southern Florida hundreds of "keys" owe their origin to the reclamation work of mangroves, whose rootstalks can resist the undermining action of wave and tide.

Another form of root that serves as a prop is not cylindrical, but flat, and resembles the great flying buttresses of continental cathedrals. Indeed, these roots serve the same purpose, for they hold up the main columns of Nature's cathedral spires—the heavy, cumbersome canopies of giant forest trees. "India rubber" trees *(Ficus elastica)*, when fully developed in their homeland, have tremendous boles which are supported by amazing tabular roots, look-

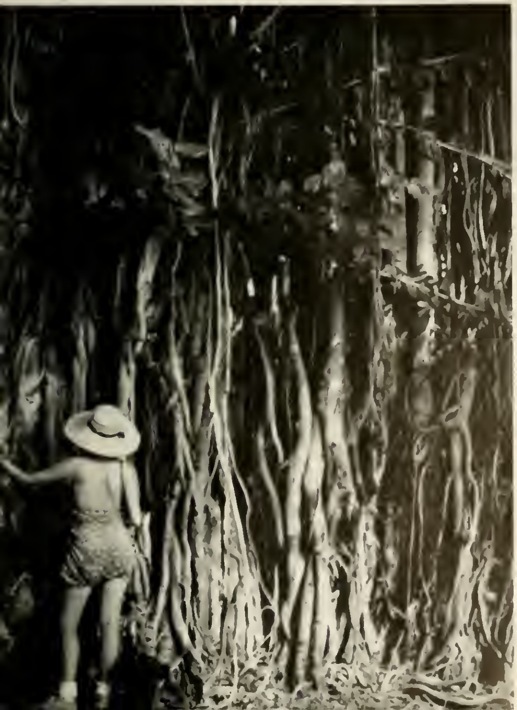
1 YOUNG BANYAN trees use pillars rather than buttresses to solve their architectural problem. Rigid roots grow down from the heavy branches to the ground. The banyan is a first cousin of the India rubber tree

2 APPEARING first as stringy "chandeliers" somewhat resembling Spanish moss, these pillar roots continue to grow throughout the tree's life, which may last 1000 years or more

3 PILLAR ROOTS, firmly fixed in the ground. Unlike true prop roots, they are extremely resistant to bending. As dutiful children, they support the parent banyan when it most needs their help

4 MATURE PILLARS. A really old banyan tree with its many offspring resembles a whole forest. One such titan boasts a leafy crown 2000 feet in circumference and is supported by 3000 pillars

3



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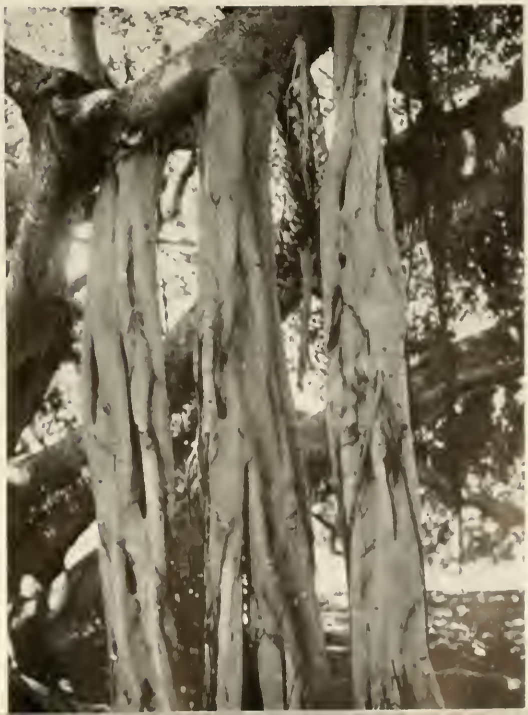


ing like so many massive planks running out in all directions from the main tree trunk.

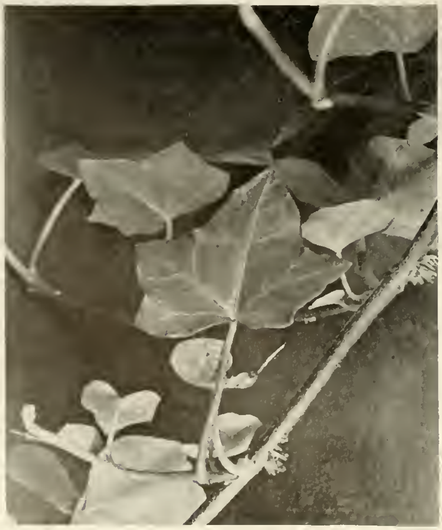
The banyan *(Ficus bengalensis)*, a first cousin of the India rubber tree, solves the support of its heavy crown not with buttresses, but in still another fashion. It props each heavy branch with so-called "pillar" or "columnar" roots. Unlike true prop roots these are extremely resistant to bending. In youth pillar roots grow out first as stringy chandeliers, which dangle nearer and nearer to earth until they finally root in the soil. Thus when the parent limb most needs help she can depend in a human fashion on her offspring for ample support. The columns continue to grow throughout the whole life of the parent (which may be upwards of a thousand years), and a really old banyan with all its many pillars, resembles not a single tree but rather a forest of trees. At Calcutta is a lusty youngster of 100 years, whose main trunk is 42 feet in circumference and which possesses 232 additional pillar root trunks, some attaining a girth of ten feet. Tradition states that Alexander the Great camped 7000 men under a banyan whose leafy crown today measures 2000 feet in circumference and is supported by 3000 "trunks."

When left to themselves these giant trees fail to develop great numbers of columnar trunks, because under the dense leafy canopy of the mother plant the soil is usually too dry and hard for hanging roots to penetrate. The banyans of "Indian figs," known as the *asvhatta (Ficus religiosa)*, are sacred to the Buddhists, who assist Nature by steering the descending roots into hollow protective bamboo poles and thence into well-broken and moistened soil. At Dena Pitya on the island of Ceylon there is said to be an old *asvhatta* tree whose canopy shelters a village of 100 huts.

By means of roots many kinds of plants are enabled to climb. Certain so-called "ivies" possess roots of this category, in particular English ivy, poison-ivy, and the trumpet creeper. A close look at the stem of any of these three plants will reveal tiny, stubby outgrowths on the shaded side of the stem, which attach themselves to a wall or other support with such strength that the weight of the vine scarcely ever breaks them loose. Climbing roots never gather food, but are only for attachment. Indeed, if they fail to grasp or to touch their "ladder" they quickly shrivel and die.

The so-called "air plants," which grow upon other plants instead of in the ground, possess attachment roots which hold them tightly to their aerial seats. Many of these epiphytes absorb all their nutrients from the air. Others, collecting vegetable debris among their rosette leaves, send out peculiar adven-

(*Below*) TINY, stubby climbing-roots of English ivy. (*Right*) Epiphytes cling aloft without ground roots. Unlike parasites, their attachment roots do not sap their host's vitality. (*Anthurium palmatum*)



titious feeding roots from the stem into this happenchance "soil." Epiphytes are not always small plants, but are sometimes actual trees. The tropical clusias start life as youngsters high up in the crotch of a tree, where their seeds have been deposited by some bird. Then in order to get enough food to grow they eventually find it necessary to tap the principal storehouse of supplies, the ground, and they send down long aerial roots as pipelines. These cables are as tough and as pliant as a rope and make fine ladders or swings for the plant explorer who needs to climb in tropical forests. Unfortuntely clusias and their cables have a habit of fusing together around the trunk of the supporting tree, and as more and more of these festooning ropes amalgamate, the host finds itself encased in a living strait jacket, which over a period of years eventually strangles it.

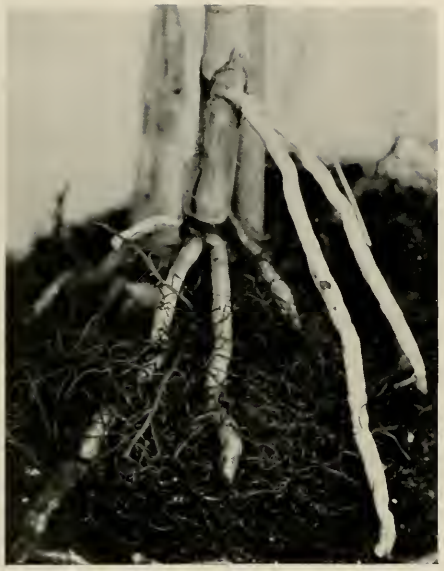
The tropical orchids boast the queerest root modifications among epiphytes, for besides acting as binding organs the roots of the aerialists have a most peculiar blotter-like covering, velamen, which sponge-like, can soak up atmospheric moisture. In addition some orchid roots even function as leaves and manufacture food—an unheard of feat in the realm of normal roots. Chlorophyll-bearing roots of this type reach their most spectacular development in *Taeniophyllum,* an epiphytic orchid which is "all roots" and has no leaves and stems at all.

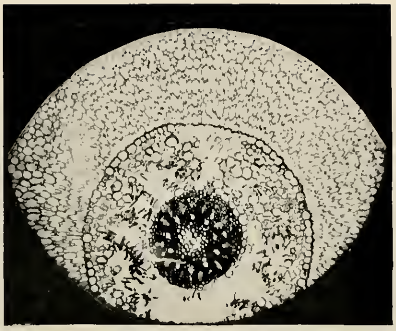
The layman frequently confuses epiphytes with parasites. The latter actually draw upon the supporting plant for nourishment. This is an easy mistake, for air plants certainly look like parasites when growing on their treetop perches. However, an examination of their root system shows that the epiphytes lack any penetrating sucking apparatus. Parasitic plants always possess this equipment, and life would be impossible to these jackals of the plant world without it. Their root adaptations are remarkable.

The mistletoe is as typical of the parasites as any. Birds distribute the sticky seeds. Upon germination on a tree limb, these seeds sink the queerest of roots into the living tissues. Their root system resembles a many-tined rake, each tooth or sinker of which represents a sucking organ that can tap those pipelines in the living tissues of the host, through which are pulsing the foods so laboriously manufactured. As this rake-like affair develops in size so does the external green foliage of the mistletoe, until a time is reached when there is no hope of eliminating the parasite,—for every time the exposed part is hacked away, the roots send up a half dozen different new plants to take the parent's place. Even more degenerate than the woody mistletoes are the herbaceous dodders—those orange twining vines that are so com-

(Below) PECULIAR feeding roots creep out into the debris in the rosette base of *Anthurium hookeri*

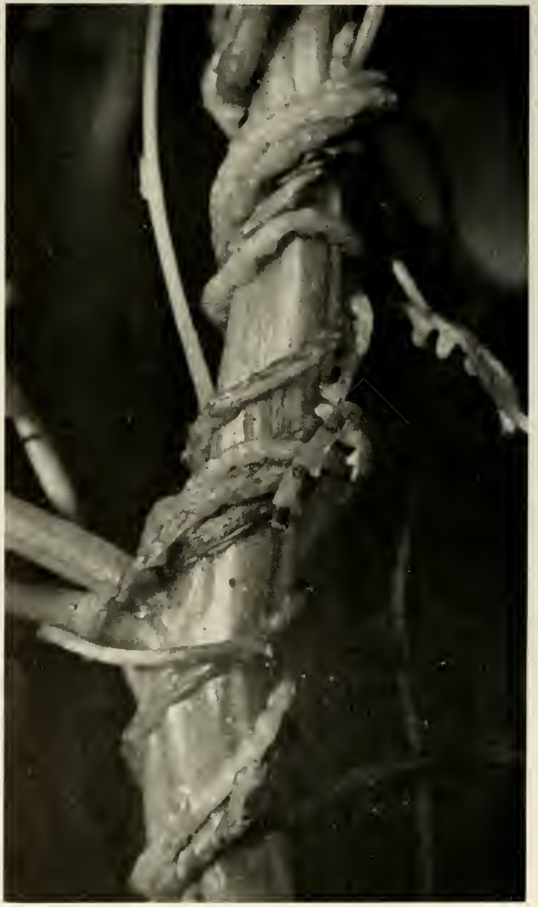
TREETOP clusias send these aerial pipelines to earth for food. Sometimes they strangle the host





(Left) WHITE blotter-like velamen covering the aerial roots of an epiphytic orchid. Above is a cross-section showing the loose outer cells which can soak up moisture from the atmosphere. Some orchid roots even function as leaves and manufacture food—an unheard of feat in the realm of normal roots.

Below, by contrast, is a true parasite, the octopus-like dodder vine, siphoning the life juices of a jewelweed by means of penetrating knob-like roots



mon along country roadsides. Total inability to manufacture food—as is shown by the lack of green chlorophyll—makes it even more necessary for the young dodder plant to contact a life-giving host. Look at a mature dodder and you will see how its penetrating knob-like roots enable this parasite to siphon the life-juices of any herb so unfortunate as to be grasped in its octopus-like grip.

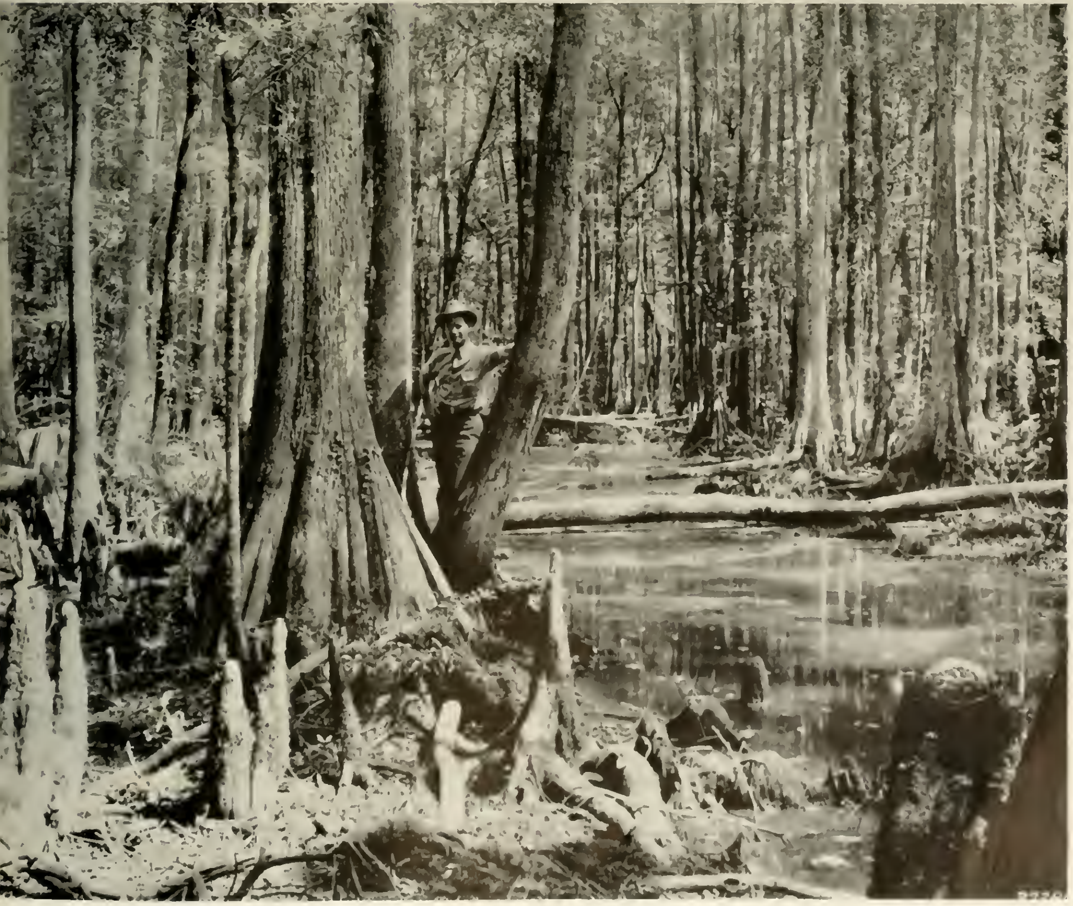
Like all living things, plants need and breathe oxygen in order to live; and every portion of a plant takes in oxygen, even the underground root. When soils become too compacted or if water stands upon normally well-drained soils, plants develop poorly and are apt to die. The roots have been drowned. But some trees, with which many of us are familiar, cannot be drowned. Like divers they possess air hoses which keep their submarine growth-activity continually supplied with fresh air. The bald cypress *(Taxodium)* of our southern swamps has just such an apparatus, enabling it to live in soil and water low in oxygen and often charged with deleterious gases. From the muck of their swamps, cypress roots sprout off and send up peculiar conical outgrowths known as "knees," which stand well above the water level. The bark of these natural ventilating systems is spongy and is filled with air spaces which allow oxygen to pass freely to the submerged portions of the tree. Black mangroves *(Avicennia)*, living in salty tropical swamps, have similar organs which, though much smaller, are more numerous than cypress knees. These stick up like so many fingers in the shallow tidal water.

Roots are as variable as Nature herself. When they form a normal underground system they act as the plant's support and assure it of a constant water supply. As migrants out of their natural earthy element they may prop, climb, bind, parasitize, or fend for themselves. They may even set up natural "air conditioning" systems.

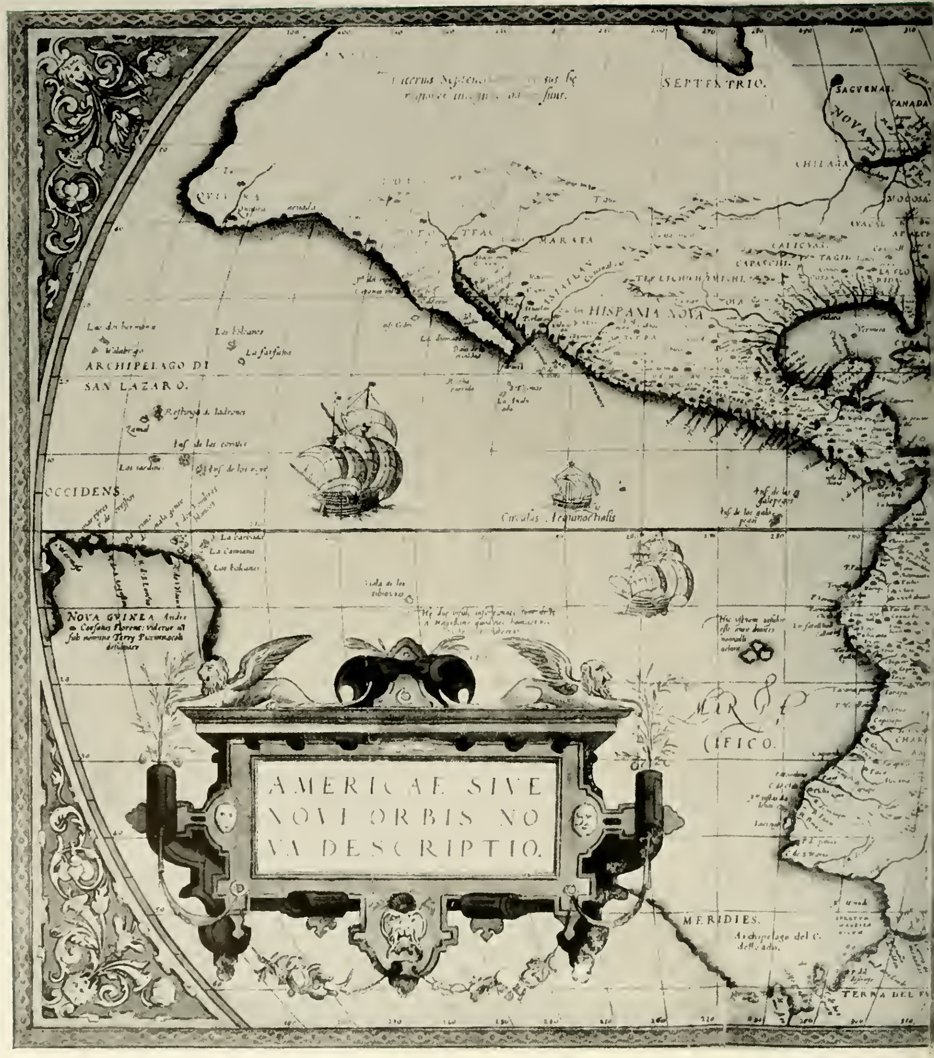
(Right) Black mangroves, with their finger-like aeration roots growing out of a salty tropical swamp. These roots supply oxygen to submerged sections of the plant and prevent drowning

(Below) Cypress knees: natural ventilating systems. These peculiar conical growths sprout off from roots that are in water or soil low in oxygen. Their bark is spongy and filled with air spaces. Thus they can convey oxygen to submerged portions of the tree and enable it to grow even in swamps charged with harmful gases

U. S. Forest Service photo by B. W. Muir



The Story of our

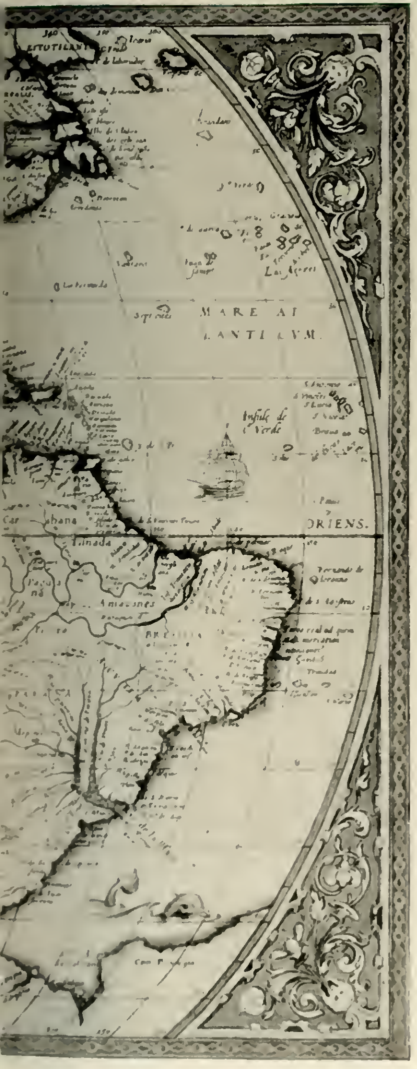

SEPTENTRIO.
SAGVENAS
CANADA
CHILAGA
HISPANIA NOVA
ARCHIPELAGO DI SAN LAZARO.
OCCIDENS
Circulus Aequinoctialis
NOVA GVINEA
AMERICAE SIVE
NOVI ORBIS NO
VA DESCRIPTIO.
MERIDIES.
TERRA DEL

MAP

The epic of North America takes on new meaning when we examine the maps the early navigators and pioneers were forced to rely upon when they ventured into the unknown

By IRENE F. CYPHER

The American Museum of Natural History



"IF YOU wish to sail from one port to another, here is a chart, and a straight line on it, and if you follow carefully this line you will certainly arrive at your port of destination. But the length of the line may not be correct. You may get there sooner or you may not get there as soon as you expected, but you will certainly get there." Such was the instruction given by the great map maker Mercator, on his Famous Chart of 1569.

For years we have all diligently learned that Columbus discovered America in 1492, and unconsciously in the recesses of our minds we believe that following this event of world importance the map of the New World sprang full-grown into existence. Actually Columbus was probably not the first European to touch the New World. The Norse were familiar with Greenland several centuries before and had probably reached the continent. And as for the map, several hundred years were to elapse before it was to begin to assume its now familiar outlines. Today we watch the map of Europe undergoing rapid changes. Such changes pale into insignificance when compared with the really radical changes in maps which followed in the wake of that epic voyage by Columbus. Adventure, romance, discovery, exploration, a mixture of knowledge and misunderstanding, a dawning realization of the extent of the great New World, and finally the complete picture, correctly drawn and with missing details supplied by pioneers, adventurers, settlers and serious map makers—this is the story of the New World map. And a curious story it is, too.

Many of the so-called "primitive peoples," whose cultures may be studied in the collections at the American Museum of Natural History, made and used more reliable types of maps than did the explorers and navigators of Europe in the fifteenth and sixteenth centuries. This is particularly true of tribes which led a wandering life. Arctic explorers have frequently been grateful for rough maps made by Eskimos. The Montagnais and Nascapi Indians of Labrador had a facility in drawing maps on bark. Islanders of the Pacific region were equally facile in certain forms of cartography. The Marshall Islanders in particular made odd "cane charts" which were remarkably accurate guides for sailing in and among the islands. Captain Cook had good reason to be grate-

(Left) SOUTH AMERICA was badly out of shape in this map, but the Gulf of Mexico is fairly accurate. The Aztec emperor Montezuma gave Cortez a map of the Gulf Coast, which may have contributed to the accuracy of this one drawn by Ortelius in 1570

ful to a Tahitian native who supplied him with excellent guide maps.

Columbus in setting out followed in part what were known as portolanos or portolan charts. These were sailing charts made by Italian and Catalan mariners and merchants of the Middle Ages to guide them in their journeys along the coast of Europe. Although not strictly speaking maps, the portolanos represent the most accurate guides of their time. And they were the forerunners of the Golden Age of map-making, an age which was made possible by the great discoveries of the fifteenth, sixteenth, and seventeenth centuries and which produced the first known maps of the New World.

This Golden Age, during which the great map makers of the Flemish, French, and English schools flourished, was one in which accuracy often suffered for the sake of art. The maps made then were veritable masterpieces of craftsmanship. Indeed, they were so beautiful that great painters such as Jan Vermeer and Peter de Hooch used them as backgrounds in many of their paintings. When you stop to realize how long it was before information brought back by the explorers of the day could be verified, you can understand and forgive these cartographic workmen if they filled in the unknown spaces on their maps with strange animals and took liberties with shore lines.

Columbus himself believed that the land he had come upon was a series of islands off the shore of Asia, some of which were so large and so situated that they interfered with his finding the desired passageway to India. He must have had some personal doubts of his map-reading ability, for on June 12, 1494, during his second voyage, he made all in his party swear before a notary that the land they had just touched (Cuba) was the mainland of Asia. Even the map maker Juan de la Cosa, who was with him, signed this fantastic oath. The penalties for not signing were a monetary fine or the possibility of having one's tongue slit every time he denied the statement.

How America got its name

As information about the new lands slowly filtered back home, the map makers in Europe were kept busy with new names. The great German cartographer Martin Waldseemüller in 1507 first affixed the name "America," to what we now know as South America. It was a Latinized version of Amerigo Vespucci, the name of a Florentine voyager whose travels have not been completely verified even today. Waldseemüller in another map made in 1513 omitted the name "America" and called the section "Terra Incognita," but the first name persisted and proved popular. Mercator started to use the name for both the American continents.

From this time on, the outlines of the New World began to take more accurate delineation, thanks to the explorations of the Cabots, Cartier, Balboa, Magellan, Cortez, Pizarro, and Coronado. From the reports of Cortez, Ortelius was able to give us an excellent map of Mexico as early as 1570. Cortez made extensive use of a map of the Gulf Coast which had been presented to him by Montezuma and was painted on a material known as *nequen* cloth. Indeed, the Spaniards found many kinds of maps in use among these strange people whom they came to conquer. In Peru they found not only survey maps but relief maps of the empire of the Incas. Legend has it that when the ninth Inca (about 1190) conquered a district and wanted to colonize it, he would have relief maps made for study purposes, and these are said to be the first relief maps on record.

South America seems to have presented less of a problem to the map makers than did the northern continent. The majority of the early maps show a South America of the relative contour and size we recognize today. For some time the southern part of Chile was less accurately drawn than the northern and eastern coasts of South America, until the hardy mariners of the clipper ships sailed their vessels around the tip of Cape Horn and up into the Pacific. In addition to bringing back silks and furs, they brought back information about the Pacific regions and the western coast line.

The Island of California

It was the northern continent that presented the strangest problems to the European map makers, particularly the regions of modern Alaska, California and northern Canada. It is not surprising that early travelers in these sections encountered difficulties when they tried to follow the maps of the time. An early map of the Western Hemisphere by Sanson, the French cartographer (probably about 1630), distinctly shows Lower California as an island, although Ortelius in his world atlas published in 1570 clearly indicated it as a peninsula, as did Mercator in his maps. This difference of opinion is reflected in maps of lesser known makers, and one wonders whether the explorers of that period tossed a coin to decide which map maker was correct. Practically all maps of the latter part of the seventeenth century show Lower California as an island, and it remained for Guillaume Delisle, the great French cartographer, to designate it positively as a peninsula in 1700. The French were more scientific and exact than the Dutch in their drawing of maps, and Delisle had accurate information supplied by Father Kino, a padre who had traveled overland to California, and who could therefore speak firsthand. We will never know how many early voyagers were misled by incorrect maps, and it is interesting to speculate on the difficulties encountered by unsung heroes who tried to find the "Island of California" and whose exploits vanished with them in their fruitless search.

The elusive Golden Gate

Today San Francisco and the Golden Gate seem almost synonymous, and yet for years none of the reports or maps of the early explorers so much as hinted at the possible existence of the Golden Gate. We know definitely that Sir Francis Drake spent 30 days in the vicinity of what is now San Francisco, yet he makes absolutely no mention of the famous bay and cliffs. The first actual mention of the Golden Gate appears in a navigator's report in 1768. Geologists assure us that the formation of the Golden Gate dates from far back in the geologic past, so perhaps Drake and other navigators failed to include it on their maps because they could not see through the fogs which sometimes enshroud it. Even Jodicus Hondius, in tracing the voyages of Drake from 1577-1580, inserted an inscription which has been translated as follows: "Someone will probably wonder that in this map we have left the face of the earth bare, but since it is our purpose only to represent the voyages of Francis Drake and Thomas Cavendish, it seemed unnecessary to describe the interior of the earth back from the sea coast, nor can all the names along the shore well be put down for want of space, since the shore is usually occupied with tracing the voyages on the sea. Wherefore let it suffice the reader if we mention the places seen by the navigators. . . ."

The mapping of the Pacific region involved the Spanish, English, and Russians, and the entire story is a fascinating romance. A map of 1535 made by Hernando Cortez showed the coast of Mexico and the lower tip of California. Other maps followed as a result of expeditions by Vizcaino, Drake, Bering, Cook and Vancouver. The search for pearls, furs, commercial supremacy, and colonial conquest all contributed to more accurate maps. Of course for years progress in accurate mapping was retarded by a tenacious belief that the Atlantic and Pacific were relatively close to each other. This idea is evident in the maps of the colonial days, which fail woefully even to approximate the width of the North American continent. It is also responsible for the famous "sea-to-sea" grants which were a part of so many colonial charters. It took a long time to dispel hopes of finding that shorter route to India and China, that dreamed-of Northwest Passage!

One wonders what dreams of wealth and empire were aroused by the announcement of Vitus Bering, a Dane sailing in 1728 under the patronage of Peter the Great of Russia, that there *was* a sea to the east of Asia. A map exists today, made by Gerhard Müller, a German in the court at St. Petersburg, which makes direct claims to Russian possession of these New World regions, and which indicates a sea now known as Bering Sea. It is said that many manuscript maps still exist which were made as a result of Russian expeditions of this period, and still await publication. Spanish, English, and Russian maps of this region show considerable variations of latitude and longitude, although by 1800 most of the important places had been located. A map published by the Spaniard Navarrete in 1802, was used up to 1850, as were the charts of Vancouver and Arrowsmith, Englishmen of the same period, who based their work on this Navarrete map.

Vanishing isles

Even today the Pacific presents problems for the map maker, in the form of "disappearing islands." These are tiny portions of land which apparently are submerged for varying lengths of time and whose existence is consequently somewhat problematical. One of these islands is in the Tonga Group and is known as Falcon Island. Another is an island about midway to Hawaii that is recorded on some of the very earliest charts of the Pacific. It is said that the warship *Levant,* on which the hero of *The Man Without A Country* was imprisoned, was finally wrecked here. But the island itself has not been seen of late years. There are other islands of this type scattered throughout the Pacific, and map makers would have a jolly time keeping record of some of them as they appear and then disappear.

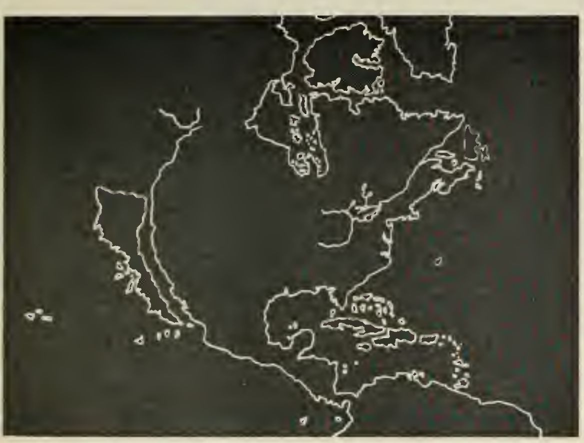
Of course, the first maps of this New World were those of sections along the Atlantic coast. The early expeditions of Sir Walter Raleigh resulted in the first known map of Virginia. Then John Smith in 1608 sent to the London Council a "mappe of the Bays and Rivers" of Virginia. There is a story to the effect that Henry Hudson had a copy of this map with him when he, too, started to seek the Northwest Passage. This same map was also referred to in the settlement of the boundary claims between Virginia and Maryland as late as 1873. Smith also made a trip farther north and in 1616 published his "description of New England." The Pilgrims knew this map, and they retained his name for the section. In the upper left-hand corner is a picture of Smith, designated "The Portraictuer of Captayne John Smith, Admirall of New England."

Naturally the maps of the early days reflect the

A *New* Continent

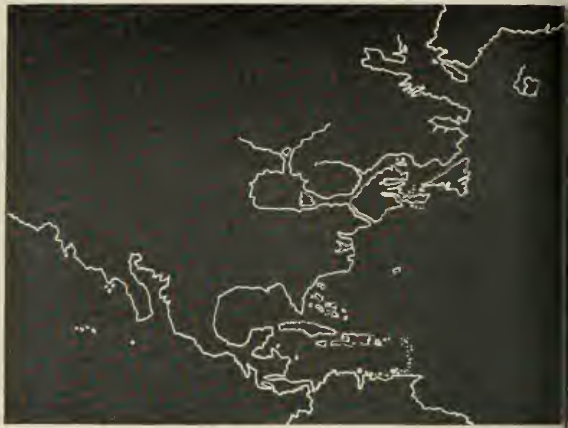
1531

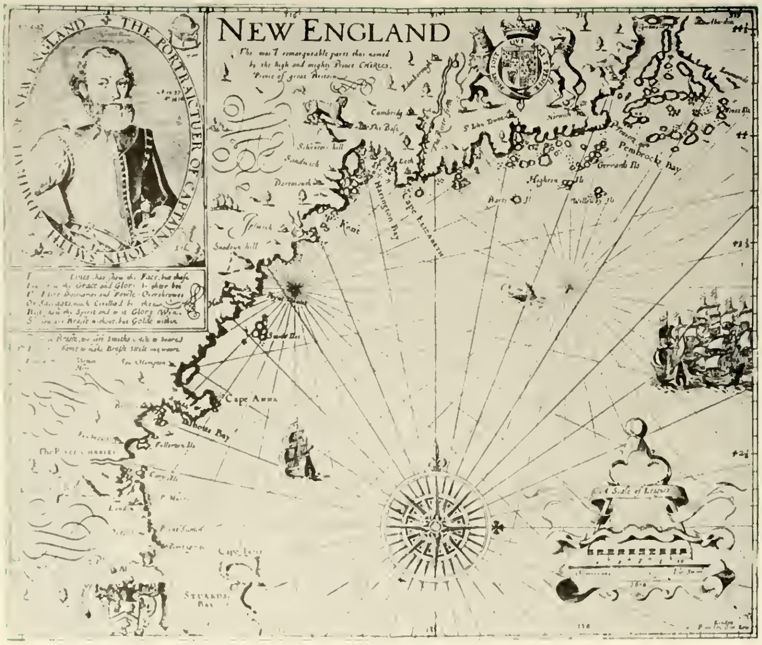
Lower California was an island, and a large inland sea in the Great Lakes region was imagined. Yet Hudson Bay, so remote from modern centers, was fairly well defined



1584

The map drawer has rightly joined Lower California to the mainland but has added some new mistakes. The inland sea is expanding westward and northward, while Hudson Bay has been lost entirely




NEW ENGLAND
The most remarqueable parts thus named by the high and mighty Prince Charles, Prince of great Britaine
THE PORTRAICTURE OF CAPTAYNE IOHN SMITH ADMIRALL OF NEW ENGLAND
Cambridge
Pembrock bay
Cape Elizabeth
Cape Anna
Stuards Bay
The Scale of Leagues

(Left) **Cape Cod** was called Cape James *(lower left)* on John Smith's map of New England, published four years before the Pilgrims landed. Plymouth, directly west of Cape Cod, is among the few names on this map that remain today. Latitudes are quite accurate. But if a modern navigator followed it for longitude he would expect to run aground on the North American continent 1300 miles out in the Atlantic

(Right) **The western and northern** coasts of North America were the last to be mapped. The important voyage of Vitus Bering in 1728 proved that Asia and America are separated by a narrow strait, which now bears his name. On this map, dated 1758, the coast of Asia is fairly exact, but Alaska has not yet taken form. It is designated "Land of which one claims to have indications from the inhabitants of Kamchatka. Some maintain that one can see it from the Isle of Bering"

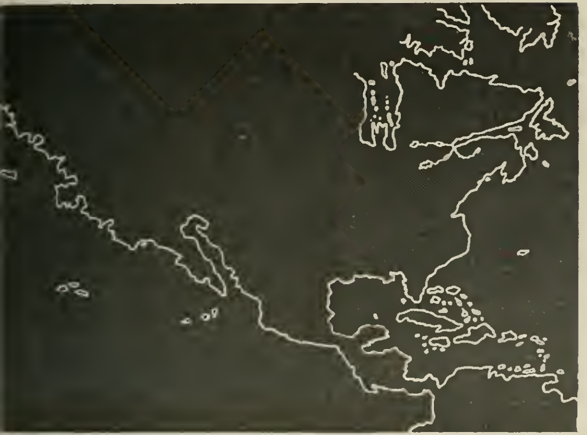
Takes Shape

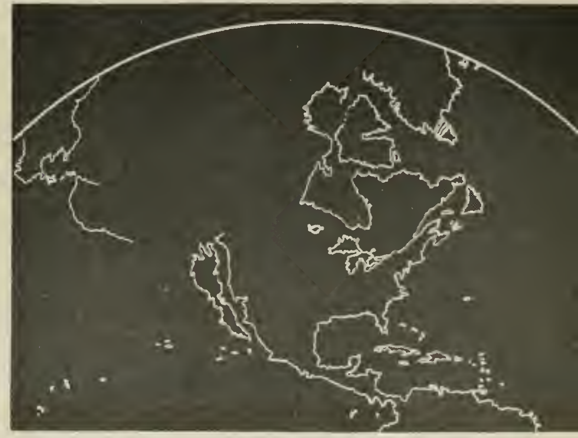
1587

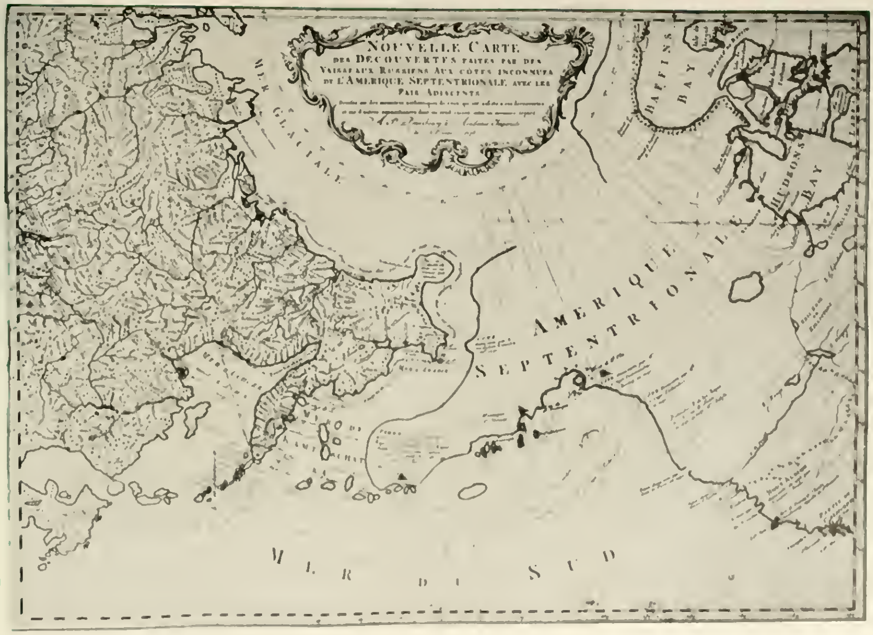
The inland sea has been erased in favor of some scattered bodies of water which hardly do justice to the Great Lakes. Hudson Bay reappears in the wrong shape

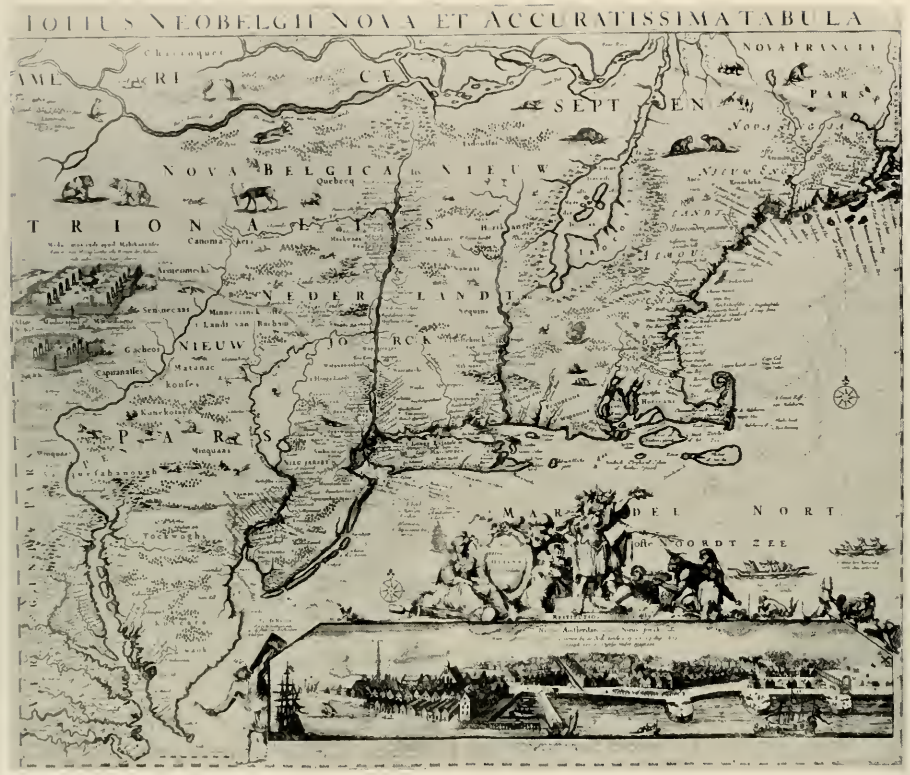
1686

The Island of California is resurrected, but the Great Lakes take some semblance of their proper form. The close proximity of North America and Asia is indicated, but far south of the proper position






Nouvelle Carte des Decouvertes faites par des Vaisseaux Russiens aux cotes inconnues de l'Amerique Septentrionale avec les Pais Adiacents
Mer Glaciale
Baffins Bay
Hudsons Bay
Amerique Septentrionale
Mer du Sud



This 18th century Dutch map exhibits a fine degree of artistic skill, both in hand lettering and pictorial decoration. The sketch at the bottom shows the early nucleus of the largest city in the Western Hemisphere. A number of soldiers and strategically placed cannon guard New York's water front

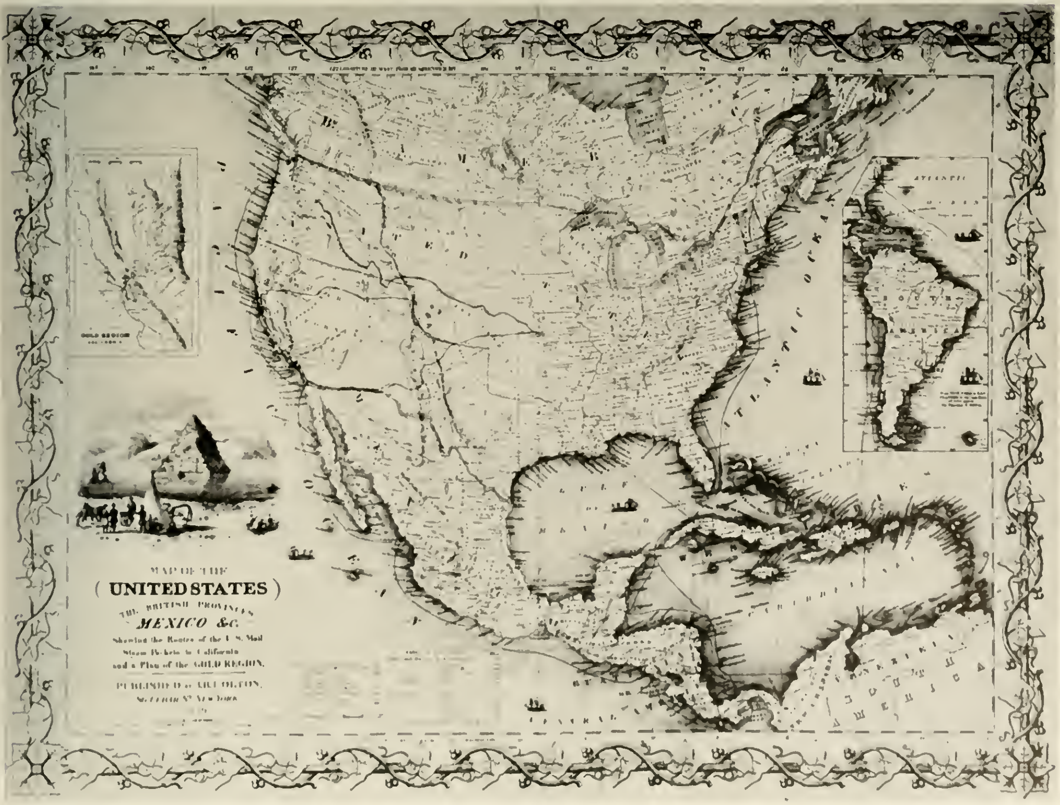
struggle for empire, which was the thing of the day. Often the nationality and allegiance of the map maker determined the facts portrayed in his maps. Even Delisle in a map of 1717 of the Louisiana and Gulf regions, in which he traced the rival Spanish and French claims, gives more weight to the claims of the La Salle expedition than to the De Soto expedition of some 145 years earlier. Delisle did, however, give a fairly correct delineation of the Mississippi River and the Appalachian and Rocky Mountains. Another Frenchman, Champlain, although he relied more on a well-trained eye than on absolute mathematical calculations, gave so accurate a description of the St. Croix River that the arbitration commission of 1794 was able to determine part of the eastern boundary of the United States, proving that his St. Croix was what they knew as the Schoodic River.

These early maps, although concerned with the New World, were all printed in Europe. It remained for one John Foster of Boston to make the first map printed in America, in 1677. It was of New England and was a woodcut. As first printed in Boston, it referred to the White Mountains as "The Wine Hills," an error which was corrected later in an edition printed in London. Slowly but surely American map-making began to come into its own. One finds the names of Lewis Evans, John Mitchell, James Turner, Washington, Jefferson, Hill, and Hutchins in the roster of contributors to the making of the map of the United States. Benjamin Franklin himself, famous for so many other things, is responsible for the first map or chart of the Gulf Stream. A cousin of his, Captain Folger, was in command of one of the mail packets from London, and the information which he supplied enabled Franklin to chart the course of the Stream. Ships following his chart were able to save at least three days in their sailing time across the ocean.

The establishment of the new government meant that new territories must be mapped and state boundaries fixed. Many of the original grants and charters were woefully vague, and the conflicts were legion. If one were to consult the well-known "Bowle's One Sheet Map of New England" (1794-1798), he would see many indications of these boundary disputes. Only the Revolution itself is said to have prevented actual warfare between Vermont and New York over their common boundary. The western boundary between Massachusetts and New York was long in being settled. The boundary between Massachusetts and Connecticut was not decided until 1804, and it was not until as late as 1899 that the boundary of Massachusetts was finally agreed upon to the satisfaction of all.

Probably John Mitchell's "Map of the British and French Dominions in North America," published in 1755 in London, should be called of paramount importance to Americans, for it is remarkably accurate for the period and was the one used in Paris by the peace commissioners of 1782-1783. One might say it was the beginning of the map of the United States. Many maps came after it—with details filled in by courageous pioneers such as Lewis and Clark, Bonneville, Zebulon Pike, Walker, Fremont, and others. States appropriated considerable sums for state surveys. The General Land Office sponsored a series of maps of territories, and atlases of the maps began to be published. The most outstanding of these atlases was that of Henry Tanner, published in 1823. The maps in this were surprisingly accurate in some respects, yet even he indicated several large imaginary rivers on the Pacific coast, whose existence, course, and origin were still legendary as late as 1838. In common with other map makers he did not seem to realize that an extended flow from east to west was impossible because of the intervening Rocky Mountains. But to his credit it must be said that he expressed some doubt as to the validity of some of these features.

The Civil War demonstrated how sadly needed were accurate maps, and in 1878 the United States Geological Survey was created to conduct an accurate survey of the vast territories belonging to the Government. Scientific mapping has progressed steadily, and it is unnecessary here to refer to the really gigantic, skilled, and commendable feats accomplished by modern cartography. For real romance, however, and the thrill, even though it be vicarious, of watching the New World grow, get yourself one of the earlier maps. Pioneers explored and settlers colonized regardless of the lack of accurate maps,—or should we say "in spite of" the maps they had. Whichever the case may be, the story of ignorance, determination, frustration, and final achievement is plainly written for all who care to see and read the maps shown here and others accessible in libraries. And if you are tempted to sigh over the rapid shifting of places and names on your map today, stop to consider the plight of the citizen of, say, 1651. At least you can be sure of your latitude and longitude,—and that is *something* after all.


MAP OF THE
UNITED STATES
THE BRITISH PROVINCES
MEXICO &c.
Showing the Routes of the U. S. Mail
Steam Packets to California
and a Plan of the GOLD REGION.

By 1849 our map accurately represents most of the outlines of the continent. This was the year of the great Gold Rush, so there is appropriately an inset showing the Gold Regions of California, as well as the routes of the steam packets to the West. Towns and cities were plentiful in the East, but the West contained many blank areas. The pioneer was still a long way from the accurate road maps familiar to all in 1942

The mineral which produces the hardest man-made substance and made possible Germany's "blitz" production of military equipment comes largely from the war-torn regions of the Far East

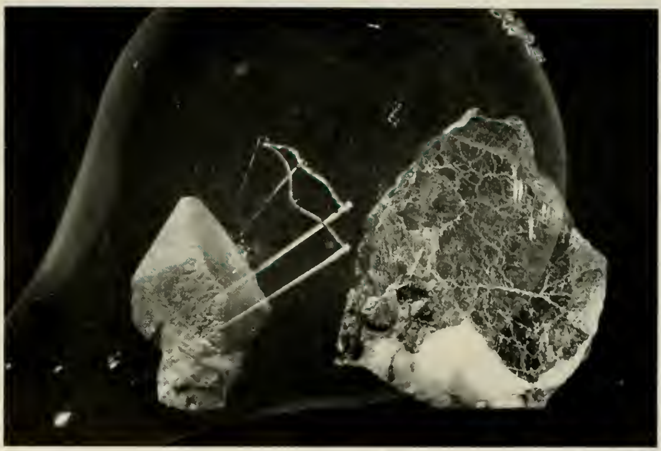
STRATEGIC METALS

NUMBER II

TUNGSTEN

By FREDERICK H. POUGH

Acting Curator, Geology and Mineralogy, The American Museum of Natural History



AMNH photo by Coles

The mineral that hardens steel and goes into the best electric light filaments is found in two important ores: scheelite *(left)* and wolframite *(right)*

THE second strategic metal in our list presents some points of similarity to the first, tin; but there are many more startling contrasts. Tin is an old metal, which in Bronze Age battles played an important part; but a list of strategic minerals made up at the time of the Spanish-American War would not have included tungsten. For until 1900, tungsten had small use, and there was little or no commercial production before the development of high-speed tool steels. Since that date, however, its consumption has increased rapidly, roughly paralleling steel production, with a steadily climbing percentage of tungsten to steel.

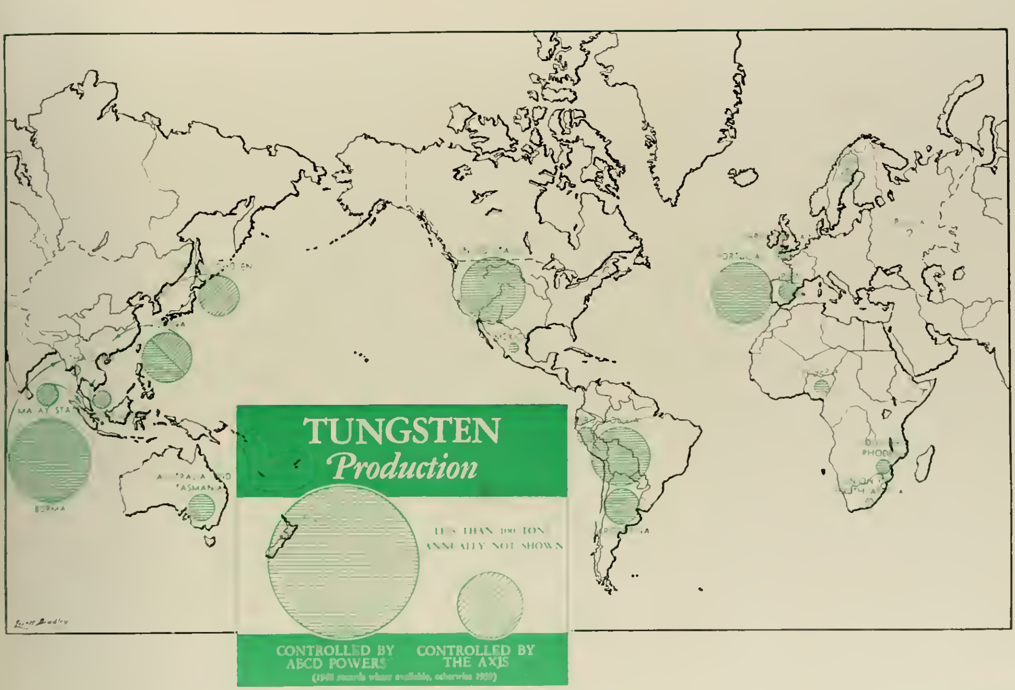
Tungsten is hard, dense, and silvery, and it has a melting point higher than that of any other metal—over 6100° F. This is so high, in fact, that tungsten can only be melted in an electric furnace, and in actual production and use it is never melted. Recovery from the ore is made in two ways: either an iron tungsten alloy is produced and then added to the steel, or the metallic powder is made by reduction with carbon of sodium tungstate, which has been made from the ore.

Tungsten steels have the remarkable property of remaining hard at extremely high temperatures. Even at red heat they are not softened. It will readily be seen that such material has a great advantage over ordinary carbon steel in machine tools. Formerly the cutting tool had to be kept cool and the casting turned slowly to keep any sort of edge on the tool. With the advent of tungsten steels, larger cuts could be made at higher speeds. It has been said that with tungsten steel cutting tools, one man and one machine can do the work of five men and five machines with ordinary steel.

Recently, tungsten carbide has been developed that is even harder than the tungsten steel, and more economical because it lasts longer. Tungsten carbide is the hardest artificial substance known, it is harder even than carborundum and approaches the diamond. Not only does it make a superior cutting tool for steels but it will also cut glass and porcelain, substances which other tools cannot work. Tungsten carbide cannot be fused. With cobalt as a binder, a finely powdered mass is sintered, that is, converted into a compact solid without actual melting. It lasts from 25 to 100 times as long as an ordinary tungsten steel tool.

The military uses are obvious. Hard covered armor-piercing shells are made with tungsten steels; gun breeches are made of tungsten alloys; and the big and little guns that often get red hot in action are lined with steel alloys of this strategic metal. Electric light filaments—the most obvious use to the ordinary man—absorb only about one and one-half per cent of the total production. Filaments use so little of the metal that a whole house with all the bulbs the manufacturers try to sell us, still contains only about one cent's worth of tungsten. But the greater efficiency of tungsten filaments over filaments of other sorts saves the public a tremendous sum.

Since tungsten is so hard to melt, the filaments of bulbs are made without ever actually melting the metal. The fine powder recovered from the final treatment is compressed, heated by the passage of an electric current, and hammered by centrifugal hammers until it becomes a solid mass. Once this is done it can be rolled and drawn, and as it is worked it becomes ever more ductile, until it can be drawn cold. The smaller the original particles, the finer it can be drawn. The final wire may be only 0.0011 inches thick—one-fourth as thick as a human hair. Pro-


TUNGSTEN *Production*

LESS THAN 100 TONS ANNUALLY NOT SHOWN
CONTROLLED BY ABCD POWERS
CONTROLLED BY THE AXIS
(1940 records where available, otherwise 1939)

longed exposure to high temperatures, as when the light is on, causes the particles to grow in size and make the spiderweb-like wire increasingly brittle. The filament will also oxidize at red heat and finally—poof! You have to get a new bulb!

Unlike tin, there are several ores of tungsten. Scheelite (a calcium tungstate) and wolframite (an iron tungstate) are the important ones. Ferberite and huebnerite are iron-rich and manganese-rich varieties of the latter mineral. In recent weeks several news items have spoken of a wolfram rush in Portugal. One suspects that the majority of reporters have not realized that wolfram is merely a European term for tungsten, and that they could have called it a tungsten rush. Wolfram and wolframite were derived from an old name applied to what was then an exasperating associate of tin ores, which in metallurgic terms "wolfed" the tin, reducing the yield.

In the foreign fields, wolframite is the most important ore. It is a common associate of tin, and it occurs in the same type of high temperature deepseated veins. One Cornwall mine produces a few tons a year. Under the stress of war conditions more is probably being recovered. A small deposit in France resembles the Cornwall veins, of which the area is a geological extension. Though figures for 1941 are not available, recent news stories would indicate that production in Portugal during the past year may have increased, as indeed it has here.

In contrast to most other strategic minerals tungsten has several ores and many sources. No continent completely lacks some sort of commercial deposit, though the larger ones seem to lie on or near the shores of the Pacific. In 1940, we imported nearly 11,000,000 pounds of concentrates, which contained almost 6,000,000 pounds of tungsten. A third of this came from China, a fourth from Bolivia. Several countries appear on our 1940 import list which were not there in 1939. Possibly the economic measures which were taken to insure our supply were beginning then to show up in importation figures. Four and one half million of the 11,000,000 pounds came from this hemisphere, the remaining five and one-half million from the now gravely threatened East.

America's tungsten prospects are not dark, however, even with the present situation. Several factors ease our problem, the most important, perhaps, being the possibility of substituting molybdenum for tungsten in high-speed tool steels. Molybdenum in seemingly ample tonnage is available in this country. Secondly, the increase of our imports from South America suggests that that continent can supply a very considerable portion of the New World's needs. New compounds, like tungsten carbide, will use more efficiently the shortened rations. "A pound of tungsten used in carbide tools will cut fifty times as much steel as a pound of tungsten in a high-speed steel tool. Reports emanating from the Krupp Works, Germany, attribute the 'blitz' production of Nazi military equipment to the tungsten carbide (widia) tool."[*] There is little chance that increased reclamation will play a greater part, for the high cost of tungsten has always caused tool steel scrap to be guarded carefully.

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[*] *The Mineral Industry during 1940*, ed Roush (New York, 1941), XLIX, 619

Continued on page 122

Fifth installment in the story of animal life

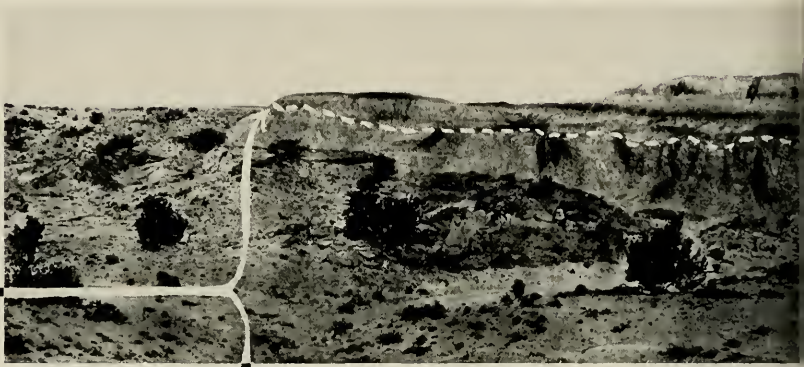
After dominating the world for millions of years the dinosaurs come to an abrupt end and—

The

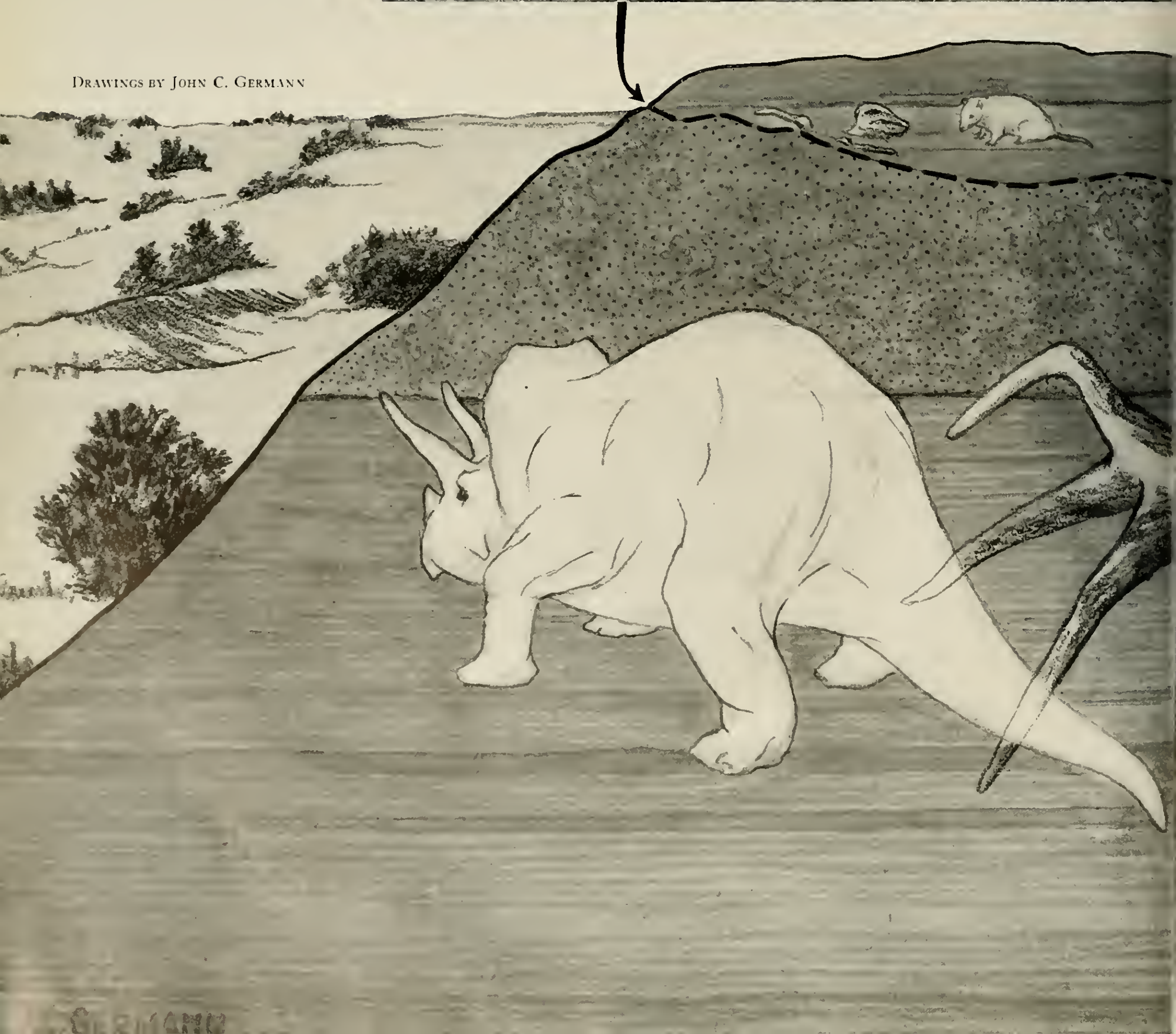
By GEORGE GAYLORD SIMPSON

Associate Curator of Vertebrate Paleontology, The American Museum of Natural History

(Right) DEAD LINE of the dinosaurs. This dotted line marks the most dramatic and perhaps most important event in the earth's history. It shows the end of world domination by the cold-blooded animals and the rise of the warm-blooded. The scene is an actual fossil ground in New Mexico. Below is seen the shadow of a huge horned dinosaur; above, some of the feeble but sprightly furred creatures that were to take over the earth



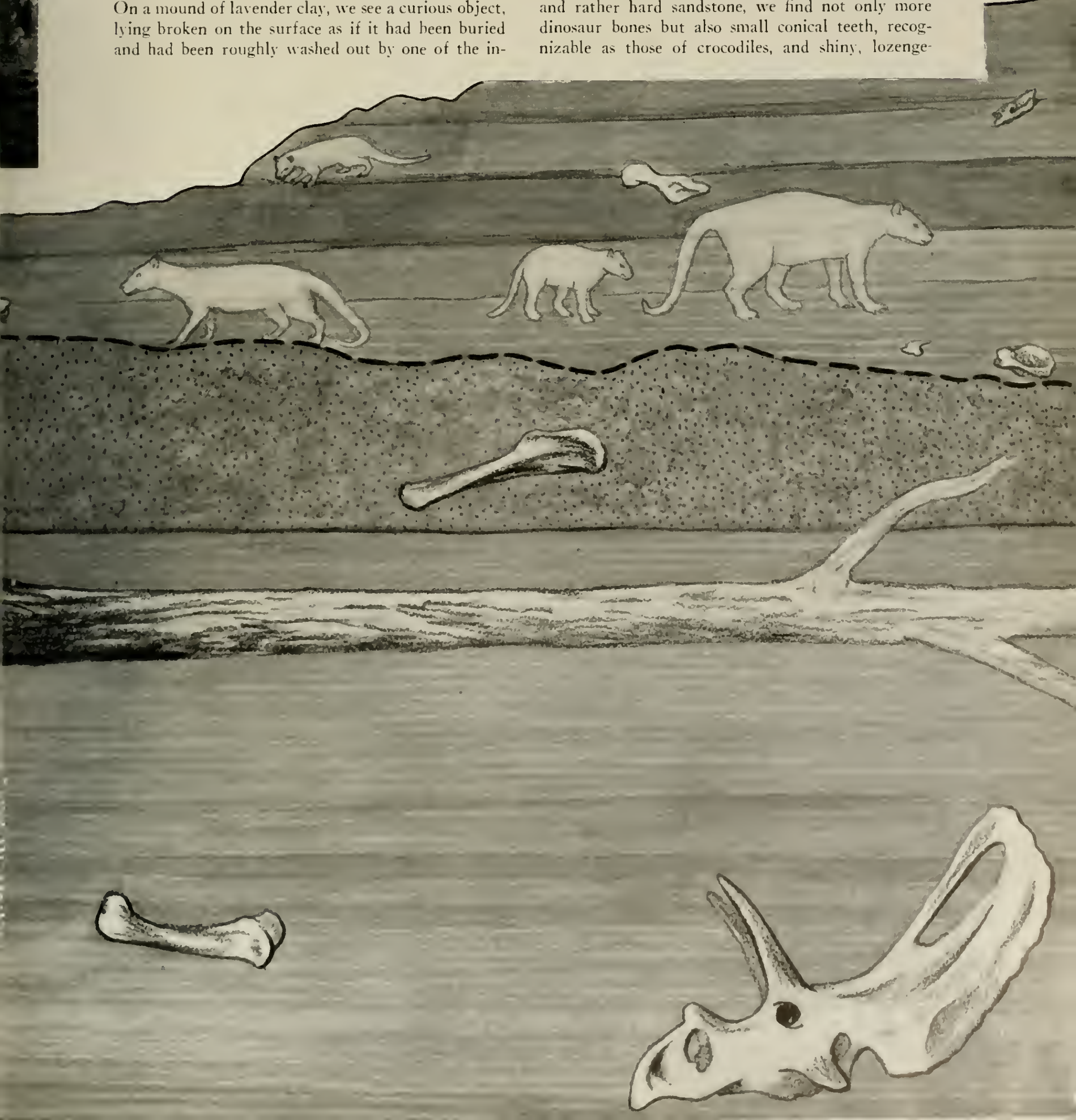
DRAWINGS BY JOHN C. GERMANN



meek inherit the earth

LET us take a walk in New Mexico. We shall start in the northwestern part of the state, near the ancient Indian ruin of Pueblo Bonito, and walk to the northeast, up a sandy arroyo, a watercourse now dry but subject to occasional brief, violent floods. Today the earth is parched under a burning sun, and the scanty sagebrush is dull green and dusty. The sand is blown into ripples and dunes in the bed of the arroyo, but along the slopes are bare exposures of yellow sandstone and delicately tinted clays, carved into curious forms by wind and rain. On a mound of lavender clay, we see a curious object, lying broken on the surface as if it had been buried and had been roughly washed out by one of the infrequent downpours. It looks like a bone, but it is much larger than the bones of any animal now living in the region, it is dark in color, and it is very heavy and hard. It is the fossilized thighbone of a dinosaur.

Continuing our walk up the arroyo we pass a thick series of alternating strata of hard clay and of sandstone, one above the other. At any one point the exposed thickness is only 20 feet or so, but as we go up the arroyo we pass successively higher and higher beds in the series until we have seen several hundred feet of vertical thickness. Pausing by a thick bed of coarse and rather hard sandstone, we find not only more dinosaur bones but also small conical teeth, recognizable as those of crocodiles, and shiny, lozenge-



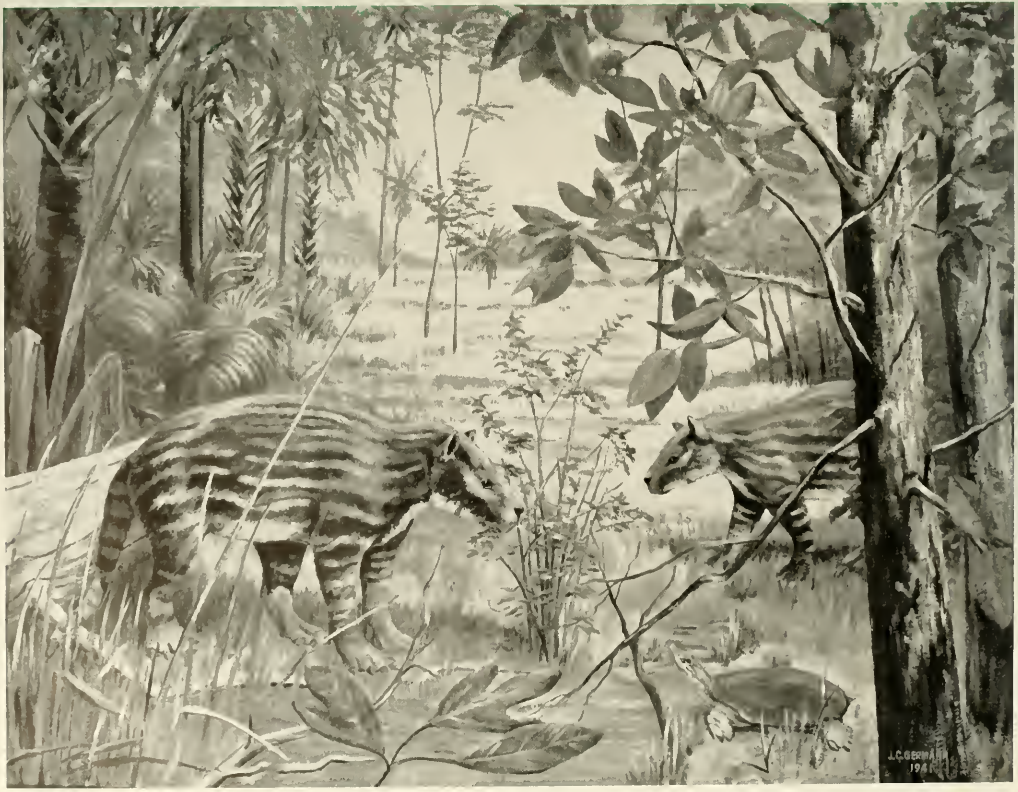
shaped objects almost exactly like the scales of the living garfish, although fossilization has turned them black. Near by is a prostrate tree trunk, 20 feet long and two feet in diameter with the appearance of fresh wood but completely silicified so that sparks fly if we attempt to sink an ax into its inviting surface.

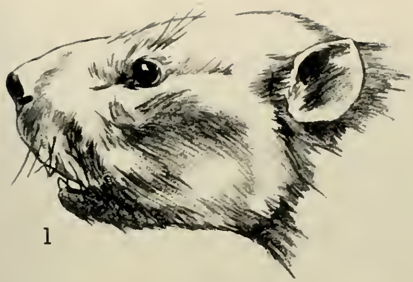
Great amphibious dinosaurs, crocodiles, fishes, and tall trees in this arid, almost treeless desert! These seem like the wreckage of a different world and so they are. These layers of rock entomb remains from the Age of Reptiles, traces of creatures and plants that died more than 60 million years ago. What is now sandstone was then soft sand, and these hard clays were then oozing mud. More sand and more mud piled up until these beds were deeply buried, and as they compacted and hardened, the remains in them were mineralized and fossilized. Later, much later, the seasonal downpours and the constant winds of this now desert region eroded away hundreds of feet of strata and carved into them the channel up which we have walked. Thus their entombed records were brought to light, so that we now find on the surface the relicts of the savage age of dinosaurs, once deeply hidden in the crust of the earth.

We have not only visited a long-lost world. We have also been walking through time, for as we ascended the arroyo, each higher layer in the piled-up series was deposited at a later time than those below. Each step upward may carry us onward ten thousand years in this record of the history of ancient New Mexico. We have traversed one or two chapters of the time of the dinosaurs, in which different species of those terrible reptiles have succeeded each other without, however, ceasing to be similar. Let us continue up the arroyo, which means also to continue later in time, to see what the next chapter of the thrilling serial may be.

The upper surface of the coarse, dinosaur-bearing sandstone proves to be sharply defined and very uneven. Filling the hollows in it is a bed of brilliant red clay above which, extending far above this to the northeast, is another thick series of red, gray, and green clays, with occasional lenticular masses of white or yellow sandstone. It looks as if the older sandstone had been eroded by the elements long ago and that after an interval fresh floods had deposited mud on this exposed surface. This is, indeed, what happened, and the sharp line between the coarse sandstone and

WHERE NOW there is desert, broad rivers meandered over fertile plains at the beginning of the Age of Mammals, 60 million years ago. The climate was moist and mild in the section of New Mexico depicted below, but mammals have since proved themselves so adaptable that there is almost no climate too rigorous for them. Thus they far outstripped the dinosaurs in adaptability. Below, a turtle—old-fashioned even in that day—looks up at a pair of condylarths *(Ectoconus)*, prophetic of the new era

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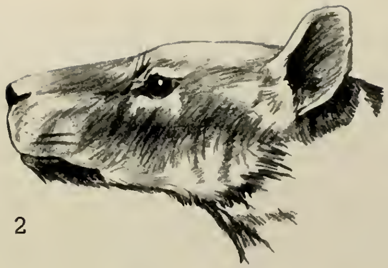
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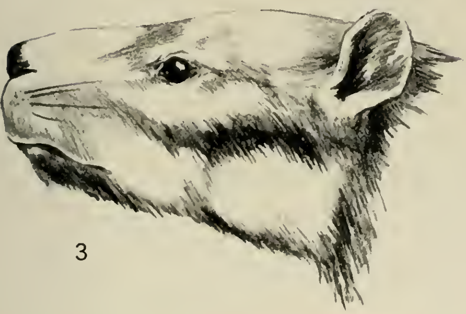
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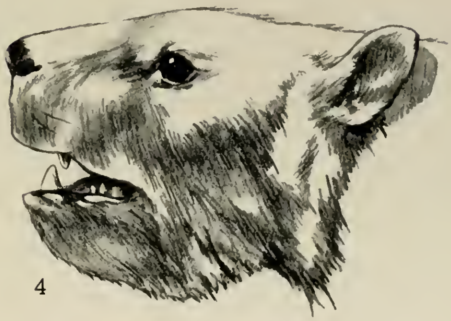
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1 Most multituberculates were mouse-like or rat-like, but *Taeniolabis* (about one-third life-size) was almost as husky as a beaver. This group gave way to true rodents

2 There were no exclusively meat-eating animals, but the creodonts were the nearest approach, of which *Loxolophus* was typical. (About half life-size)

3 The condylarths were herbivorous counterparts of the creodonts. *Ectoconus,* shown here at about one-third natural size, is fully restored opposite

4 Least promising were the taeniodonts, represented by *Wortmania* (about one-third natural size). Their descendants became specialized, then died out

the red clay marks the end of one chapter and the beginning of another. We can put our fingers on the exact spot. Mark it well, because it is the visible record of the most dramatic event that ever occurred in the history of the world. Remote as it may seem to us, that was also the most important single event that ever occurred in our own history. If it had not happened, you and I, or anything human, would never have existed.

These upper, later clays look much the same as some far below. In what way do they represent a radical change in life history? Let us search them for organic remains. The most diligent scrutiny reveals no more of the great dinosaur bones. These are all gone, left one or two million years behind us, down the arroyo. But as we adjust our search to a different scale of magnitude we begin to find much smaller bones and tiny, many-cusped teeth, wholly unlike the dagger-like or serried teeth of the dinosaurs.

The hordes of bulky, cold-blooded dinosaurs are gone, vanished as if they had never been, and in their place are other hordes, even more numerous and varied but relatively insignificant in size and apparently feeble in comparison with the least of the lordly dinosaurs. The Age of Reptiles (the Mesozoic) has ended and the Age of Mammals (the Cenozoic) has begun.

The change here appears so sudden that it seems to give evidence for the old belief that the great reptiles, Rulers of the Mesozoic, were wiped out by catastrophic divine wrath and that the earth was repopulated by the creation of a gentler breed. But we now know that evolution, by and large, is a slow process and that when its results burst upon us with seeming rapidity they must be the culmination of long ages of preparation. So it is here. These herds of mammals that so quickly replaced the dinosaurs were not the first mammals to exist but were merely the first to become abundant and widespread.

Since almost the beginning of the Age of Reptiles mammals had existed. They had been small—a mammal larger than a rat was then a giant—and they had been obscure. Probably they were confined to limited areas and to peculiar environments where the competition with the omnipresent reptiles was not too lethal. The result is that they are among the rarest of fossils. Only here and there under exceptional conditions have their remains been found: in a limestone fissure in England, in a single quarry in Wyoming, and in wind-blown sands in the middle of the Gobi Desert. These and a few other discoveries show that mammals did persist during the dark ages of reptilian dominance and that they were undergoing constant and fundamental evolutionary changes, oppressed by myriad foes, learning perforce to survive by some means other than reptilian brute strength.

The mammals may have contributed something to the downfall of the dinosaurs by eating the eggs of the latter, but they were far too feeble and too few to have been the sole or the most important factor in reptilian extinction at the end of the Age of Reptiles. As related in the December NATURAL HISTORY, the main reason for that extinction was probably that the dinosaurs finally became too sluggish and too inadaptive to meet the conditions of rapid changes in their environment.

The tiny, furry creatures that would have been the objects of scorn had dinosaurs been capable of that emotion, thus inherited the earth. They did so primarily because they were more adaptable. Their adaptability enabled them to survive the crisis of environmental change that slew the last of the giant reptiles. Once these reptiles were gone, this same adaptability enabled the mammals to multiply relatively rapidly and to adopt new modes of life, formerly closed to them by reptilian competition.

Definition of the word "mammal" means a great deal more than naming a few characteristics that enable us to recognize this kind of animal. We must also specify some of the things that enabled mammals to suceed in the struggle for existence and to take over the earth when the reptiles' long day was done. And out of this comes an explanation, partial at least, of why man himself was able to arise and to rule, for we are mammals, too, in one respect the mammals *par excellence*. The most basic mammalian character is intelligence. Small in size, without armor, without large fangs, the earliest mammals survived mainly because they used their heads. Unable to outfight dinosaurs, they outsmarted them. The essential upward trend in mammalian history is an increase in mental power, in grade of intelligence, culminating (up to now!) in man. There are, of course, relatively stupid mammals, and some of these, like the armadillo, have gone back to the old reptilian dodge of retreating into a shell; but the most stupid mammal is a mental prodigy in comparison with the most clever reptile.

The great majority of reptiles lay eggs, and all of them leave the young to fend for themselves from the start. The eggs may be spoiled by too cold a night or too hot a day, and eggs and young alike are peculiarly liable to attack by marauders against which their defenses are poor. With only two exceptions, mammals bring forth their young alive, reducing the hazards of the embryonic period to a minimum. Without exception, the young remain with the mother for some time and are nourished with her milk and protected by her against enemies. This not only enormously increases the young mammal's chances of survival but also gives it a relatively sheltered juvenile period in which it can adapt, learn, and acquire behavior patterns more complex than the almost entirely instinctive reactions of the young reptile. This opportunity to learn is related to the ability to learn—no mammalian characteristic is an isolated thing, but all are intimately correlated to produce a higher type of physical and mental functioning. The complex of growing intelligence and of juvenile care also involves the rudiments and the possibility of peculiarly mammalian sorts of conscious social structures, which again culminate in human society.

The more strictly physical structures and functions of mammals also differ profoundly from those of the ancestral reptiles. Mammals early acquired a complicated physiological mechanism for maintaining nearly constant body temperature. Thus they can survive and remain active in weather so cold that reptiles become dormant and finally freeze to death or in weather so hot that reptiles die of a sort of sunstroke. There is almost no climate so rigorous that mammals cannot somehow become adapted to it—this is probably the major secret that enabled the mammals to survive the great dying time of the reptiles at the end of the Mesozoic. Greater mammalian activity is also forwarded by improved bony and muscular structure. A mammalian thighbone, for instance, is more finished and more specifically adapted to special functions than is the corresponding bone of a reptile. A skilled mechanic at once recognizes the mammalian bone as being a better job. The mammal is capable of faster, more continuous action.

All these things—suckling the young, maintenance of body temperature, sustained activity—require a more rapid and constant utilization of energy within the mammal's body. This higher metabolism also implies a more steady food supply and a more efficient use of it. The whole body is involved in these activities, but we see them reflected most clearly, especially when dealing with fossils which preserve only the hard parts of animals, in the changing structure of jaws and teeth. The complicated reptilian jaws are made of many different bones, mechanically complex but so put together as to permit only a limited repertory of motions. In mammals the lower jaw is a single bone, strong and simple, with very wide possibilities of movement. Dinosaurs could not chew; they could only rend and chop with their teeth. In conjunction with their new jaw structure, mammals early acquired a peculiarly potent pattern of cuspidate, or pointed, teeth. This pattern was amazingly adaptable. Emphasis on one element or another in the process of evolution could produce specialized jaws equipped to take care of the most extreme varieties of food, each with maximum efficiency. Thus the mammals could find plenty where many of the reptiles would starve to death.

Those are some of the reasons why the humble, furry, little mammals were able to inherit the earth when their great chance came—when the going became too hard for the stronger, more abundant, but clumsier, less efficient, and less adaptable reptiles. Of the dozens of different kinds of reptiles in the Mesozoic very few survived into the mammalian age of the Cenozoic. None of the biggest reptiles could make the transition. Those that did survive — lizards, snakes, turtles and crocodiles—had the fortune to be adapted to environments that changed less radically and to ways of life in which they were less at a disadvantage in comparison with mammals.

Let us return to New Mexico and see what life was like there at the beginning of the Age of Mammals. The climate was certainly more moist than it is now and perhaps more equable. Broad rivers meandered over the fertile plain that is now a desert, and groves of lush trees and shrubs abounded where scraggly sagebrush now grows.

Among the swarms of mammals, there is only one that is at all familiar to our eyes: a little opossum; for the opossum is the great conservative among mammals, an almost unmodified survival from the Age of Reptiles. The time is so remote that all the other animals have since either become extinct or have evolved into something unrecognizably different. It is difficult to describe these early mammals by any names derived from the recent fauna. It cannot be said that such and such an animal was an ancestral horse, because that ancestry was not yet sufficiently horse-like to be distinguishable, or that another animal resembled a cat, because the special cat-like habits and structures had not yet been differentiated. There is really no alternative to coining distinctive names for the ancient groups of mammals, and in this archaic New Mexican landscape most of the mammals we see are multituberculates, creodonts, condylarths, and taeniodonts.

Most of the little multituberculates were mouse-like or rat-like, although at this particular time some of them had achieved considerable size and were as large as husky beavers. They had enlarged, more or less rodent-like incisor teeth, and their cheek teeth were grinders covered with rows of tubercles—hence the name "multituberculate." The smaller kinds had also a set of large, sharp, scissor-like teeth in the middle of the jaw, for slicing off the skin and rind of fruits and vegetables. In that world the multituberculates played the part the ubiquitous rodents do in ours, but they were not true rodents. They were then the oldest type of mammal, a survival from the still dimmer past of the early part of the Age of Reptiles. Somewhere, as yet undiscovered, true rodents were probably even then beginning to evolve in obscurity. When their typical structure was well developed, they spread rapidly over the world. When this happened the multituberculates quickly became extinct without issue, for the habits were similar and the rodents were more efficient in the ensuing competition.

The carnivores and herbivores of today differ from each other so much that the thought of mistaking one for the other is ridiculous. Who could think that the fierce, flesh-eating tiger might be blood brother to the placid, grass-consuming cow? But in this ancient New Mexican fauna this specialization and differentiation of habits was barely beginning. The carnivores of the time—called creodonts—were less carnivorous, and the herbivores—condylarths—less herbivorous. There were no exclusively meat-eating animals like the tiger and no grazing animals like the cow. (In fact there were no grassy meadows to graze on; the meadows came later and with them, with typically mammalian adaptability, evolved grazing from more primitive browsing animals.)

Thus the creodonts and condylarths all looked very much alike, differing only in size and proportions and in minor anatomical details clear only on careful study. They were almost all rather squat, heavy-limbed animals with five toes, each ending in what was neither exactly a sharp claw nor a blunt hoof but something between the two. Their heads had more or less the simple proportions of the head of a dog or a bear, although not as pointed; but the braincase was smaller because the brain itself was still very primitive in comparison with the brain of later mammals. Their tails were long and clumsy, slowly tapering from an unusually heavy base. These animals varied from about the size of a rat to that of a police dog—there were no really large mammals as yet. Many of the smaller forms lived mostly in the trees, while the larger ones ambled about in the forests and glades.

A few of the creodonts were already specialized to the degree that they preferred a diet of carrion and only resorted to other food under the sharp stimulus of hunger; but most of these animals, creodonts and condylarths alike, were more or less omnivorous. Probably all of them ate some carrion when they found it. The more active creodonts may occasionally have been able to kill a multituberculate or an unwary condylarth. They all doubtless relished berries, fruits, and nuts. Some of the larger condylarths probably also relied heavily on succulent leaves and shoots in their diets.

Primitive as they were, these relatively clumsy mammals were full of promise for the future. The creodonts exemplified a type of structure that was capable of progressive adaptation into all the diverse sorts of later carnivores, and the condylarths foreshadowed the even greater diversity of later herbivores.

The other conspicuous members of the fauna, the taeniodonts, held no such promise. They were already beginning to specialize in a peculiar way that did, indeed, continue and intensify for some millions of years—but eventually it proved fruitless when the stock died out without further descendants. They exemplify a sort of unsuccessful experiment in adaptation, an early, aberrant line of specialization. The smaller, more primitive taeniodonts differed little from the creodonts, but the more peculiar large forms, with nearly the size but not the form of a collie, were still more strange. They had snub noses, heavy, deep jowls, strong, gnawing canine teeth, and large, blunt cheek teeth. Their bodies were peculiarly heavy and clumsy and their strong limbs, terminating in large claws, seem to have been adapted to digging and tearing up roots.

More progressive animals do not appear in this first, archaic fauna of the Age of Mammals as revealed by the famous fossil field of New Mexico's San Juan Basin. But somewhere, still isolated and hidden, they were already beginning to arise. As the millennia passed, from time to time some of these burst the bounds of environmental and geographical isolation and spread over much of the world. Thus in a few million years the modern true carnivores were to spread and, after a long struggle, to oust the survivors of their ancestral group, the creodonts. The early four-toed horses and other ungulates were similarly destined to replace the condylarths. Most significant of all, and sooner than the incursion of more advanced carnivores and ungulates, was to be the appearance of the primates, tiny lemurs and tarsiers, first forerunners of the long line leading to Man.

Be sure to read the next installment of the story of animal life in NATURAL HISTORY *for March.*

The Story of a TREE

By H. E. Vokes

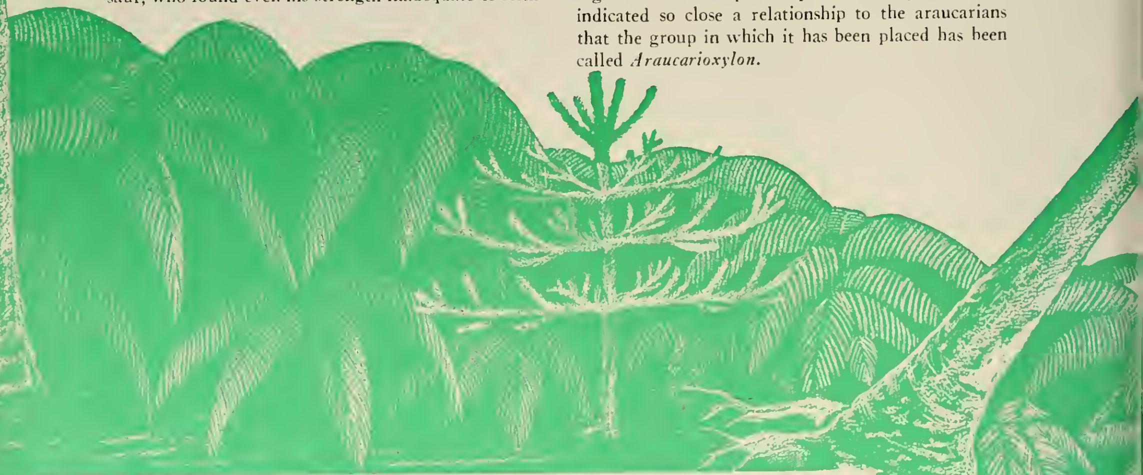
Assistant Curator of Invertebrate Paleontology,
The American Museum of Natural History

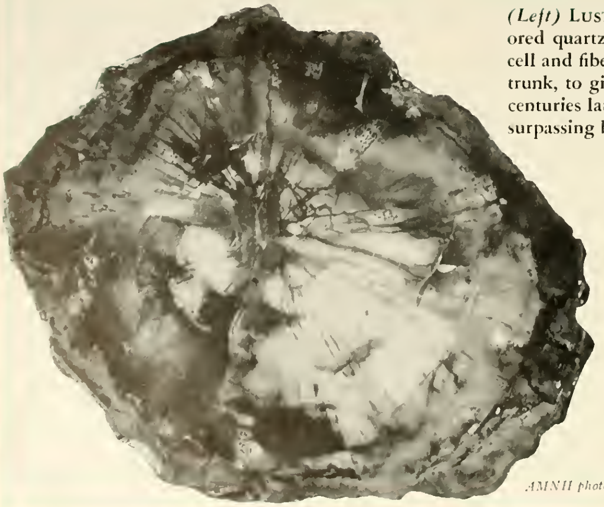
Drawing by Alastair Brown

This is the story of a tree, one of many very ancient trees which grew on upland regions of our continent 100 miles or more from the seashore. It is a story based on a fragmentary record and on the scientific assumptions derived from that record. It is the story told by the fossils and rocks of the Petrified Forest of Arizona.

The flood waters raced along with a low, sullen roar—a menacing music, whose overtones were made up of the sucking swirls of transient whirlpools and the frightened bellowing of a crocodile-like phytosaur, who found even his strength inadequate to stem the mad current. The swollen waters, their hunger seemingly unsated by the load of sand they bore, tore ceaselessly at the bend in the bank where towered the tree of our story—a giant landmark in a strange, prehistoric world.

It was a tall, majestic, unusual tree. Like its nearest living relatives, the araucarian pines of South America and Australia, it probably had a rough, lumpy bark and a bushy crown at the top of its tall trunk, with triangular leaves that were broad, short, and sharp-pointed. It was one of the early cone-bearing trees. Microscopic study of its woody tissues has indicated so close a relationship to the araucarians that the group in which it has been placed has been called *Araucarioxylon*.





(Left) Lustrous multicolored quartz replaced every cell and fiber in the ancient trunk, to give us, countless centuries later, an object of surpassing beauty

AMNH photo by Coles

A swift scientific journey through 150 million years of the earth's history tells the secrets of a forest that was immortal. —The events which gave America that extraordinary natural wonder, Petrified Forest National Monument

Many floods had torn at the bank by the great bend. Each had exacted its tribute of sand and soil; and now the undermined banks, faced with new demands, gave way. Slowly, reluctantly it seemed, the tree fell. A loud splash—a momentary note in the symphony—was followed by a new sound, as the waters hurled themselves against the inert trunk lying across the flood, held in place only by roots not yet torn loose.

Frantic with fear, the phytosaur strove vainly to battle the current which swept him into the great bend. With a crash he was driven against the fallen tree. Inert but not yet dead, the animal was sucked under the tree and hurled downstream, at times completely submerged, until he was soon drowned. A capricious current carried the body into the shallows, where it grounded. As the flood waters subsided, it was covered by sand.

More than 150 million years later a scientist found the remains. Today they are a museum treasure.

The tree rode out the flood and, as the water fell, its trunk remained a natural bridge over the stream. In the warm days that followed, its leaves dried up and the remaining roots died and became brittle.

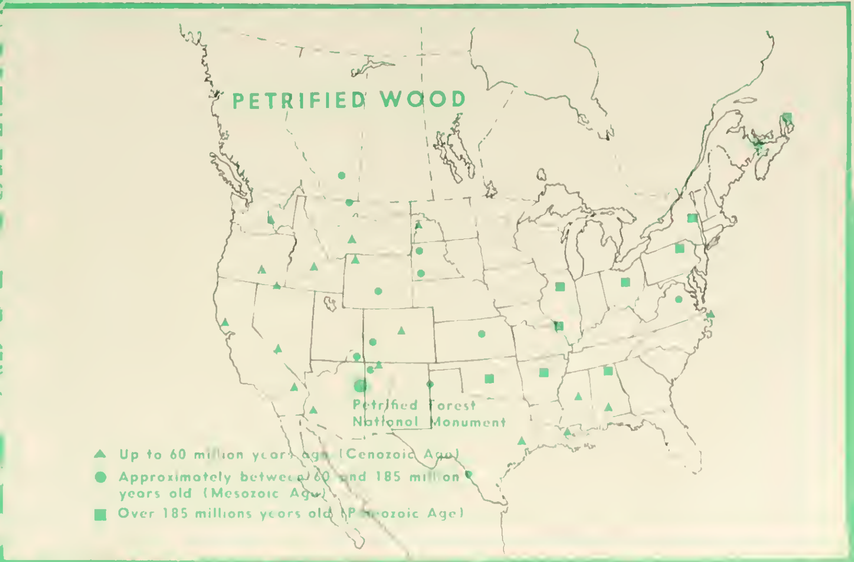
Floods were not uncommon in that country. Once again yellow waters roared down the valley. The roots snapped and the leaves were washed away. The great trunk rose again on the flood and, spinning and crashing into boulders, was borne down from the hills. The bark was stripped off, the wood torn and splintered.

One hundred miles downstream on a broad, low plain near sea level, it finally came to rest on a sand bar. We do not know how many floods aided in transporting it, but it was only a remnant of its former glory. Only the broad stump told of its former root system, and not a single branch remained.

Sand drifted around it. Distant volcanoes gave forth great clouds of volcanic ash which, carried by the winds, settled round about and buried the tree, choking streams and building up a new land surface. Across this new surface, rivers developed new courses, as more sand and more ash buried the log deeper. More trees died on the uplands and were swept down.

More than 150 million years passed. These were years when the giant dinosaur *Brontosaurus,* the "Thunder Lizard," shook the earth with his tread and passed from the scene. Fearsome *Tyranosaurus* tyrannized the descendants of *Brontosaurus* and was gone. The dinosaurs finally succumbed before the

THE PETRIFIED FOREST of Arizona is the best known to American tourists, but almost every state has its deposits of petrified wood


PETRIFIED WOOD
Petrified Forest National Monument
▲ Up to 60 million years ago (Cenozoic Age)
● Approximately between 60 and 185 million years old (Mesozoic Age)
■ Over 185 millions years old (Paleozoic Age)

new mammals, and the mammals themselves dominated the world, their evolutionary development culminating in Man himself.

But what was happening to our tree during all these million years? Buried deeper and deeper, until at least a thousand feet of sandstone, shale, and limestone lay over it, it was constantly bathed by circulating ground waters. These waters, passing through the layers of volcanic ash and other sediments, became charged with dissolved mineral matter, mostly silica. Our log became thoroughly permeated by this water; and as the wood decomposed, it was replaced, particle by particle, by the silica. Finally there was nothing left of the original tree, but in place of its wood there was a perfect replica in quartz (silica dioxide), showing even the finest details of its original cell structure.

Pure quartz is white or colorless. How, therefore, did these petrified trees acquire their brilliant reds and yellows? The circulating waters bore, in addition to their principal load of silica, traces of iron, manganese, and other minerals. The reds resulted from iron coloring, the yellows from manganese.

The Petrified Forest of Arizona might have remained hidden from human eyes had not a great movement of the earth's crust, perhaps a million years ago, lifted all the land of the Colorado Plateau, permitting the overlying material to be weathered away. The whole region was raised more than a mile above sea level, and the processes of erosion at once attacked the rocks, crumbling them so that the streams could wash them away. At last a mineralized "ghost" of our tree again lay on the surface of the land, in a world whose life and appearance had entirely changed from the time when it had last been exposed.

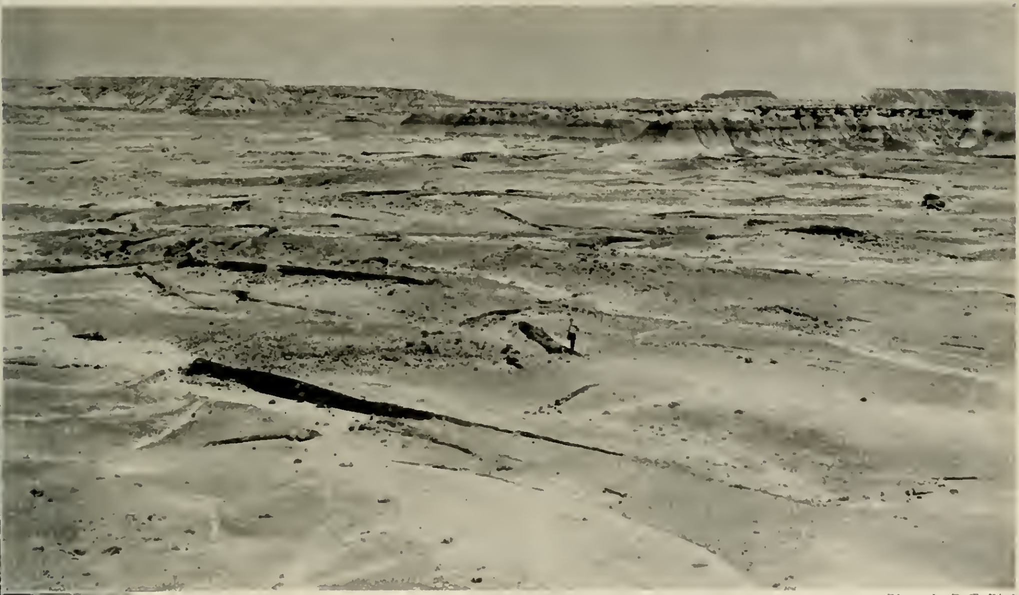
That is the story of a tree in the Petrified Forest. It may seem a fanciful tale, but it is based on the evidence that anyone visiting the Forest can easily observe. All the trees lie prostrate. All are battered and bruised. Very few show any remnants of their bark, and branches and roots are rarely found attached to the trunks. In some places the logs lie in a tangled mass resembling a log jam. Only a few stumps have been found, and one of them was completely inverted, with its roots uppermost.

All are found in sandstones that bear every evidence of being deposited when material was washed out by flooded streams. Ripple marks, current bedding, sun-cracks, and raindrop impressions tell this story, as do the shells of fresh-water clams and the bones of the crocodile-like phytosaurs found in the same rocks. Particularly significant are the well-preserved leaves of lowland, swamp-loving types of plants: ferns, scouring rushes, and primitive cycads. Only rare fragments of the leaves of the *Araucarioxylon* have been found.

Photo by Barnum Brown

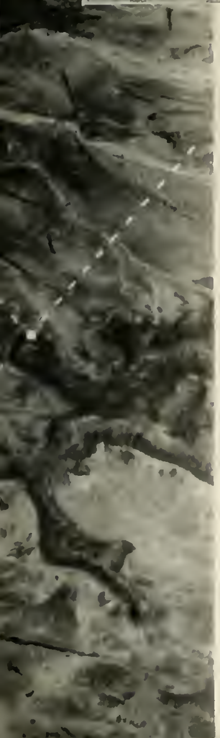
The presence of distant volcanoes is shown by the widespread deposits of ash throughout all the Painted Desert region. In fact, most of the brightly colored, banded rock layers of this region were formed when beds of ash decomposed and were leached out by the circulating ground waters, which removed much of the silica from the rocks as previously explained.

In the mythology of the Piute Indians the petrified trees are held to be the broken weapons of the great Wolf God, and the several "forests" comprising the Petrified Forest area are said to mark the battlefields where he fought. To the Navahos the logs are the bones of Yeitso, a horrible monster who was here destroyed by the Sun God. But to the student of earth history, the Petrified Forest is not a battlefield. It is rather a burial ground, where the vanquished who had fallen in a great battle of Nature waged on the uplands some distance away, were given an honorable burial. Today they form their own monument.



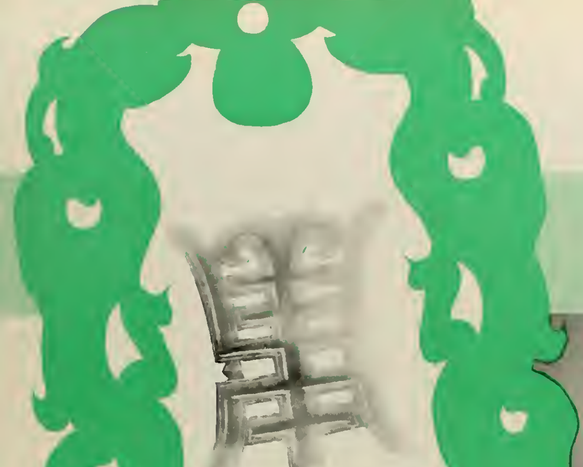
Photos by R. T. Bird

Drenched in the brilliant Arizona sunlight, the Petrified Forest is a scene of riotous colors. The minerals which the rocks gave the petrified trees did not rob the landscape of its rich hues. The Painted Desert, likewise a popular spectacle with motorists, is near by



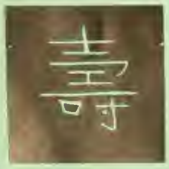
In the unusual aerial view at left the sharp-eyed reader will be able to pick out many of the logs visible in the photograph above, which was taken from the point indicated by the square. At right, a closer view of some of the logs that give us a glimpse of the world 150 million years ago

Salutations and Inscription

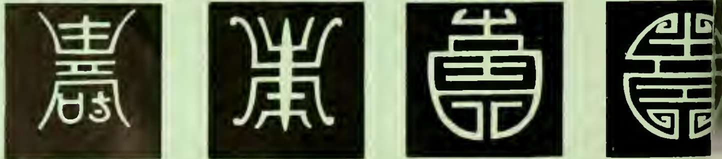


(Left) LONG LIFE, a thought frequently represented in the decorative art of China, is here expressed in a simple pendant of white jade. The approximate position of this form in the evolutionary development of the symbol can be seen below. (Whitlock Collection)

All AMNH photos by Thane Bierwert



THE ACTUAL CHARACTER for Long Life in Chinese *(at left)* evolved into many stylized variations as shown at right



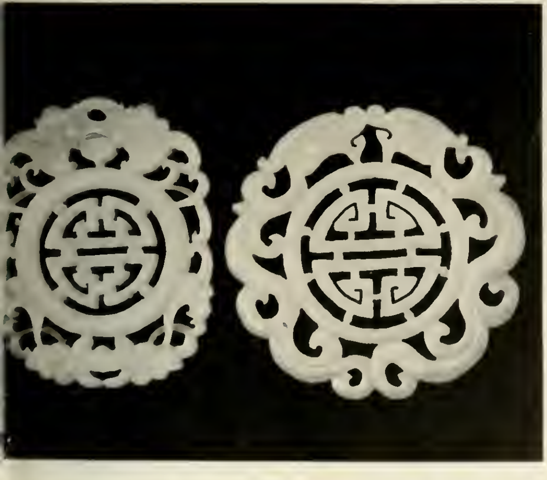
n JADE

By HERBERT P. WHITLOCK

Curator Emeritus, Research Associate in Jade,
The American Museum of Natural History

From ancient origins which the Occidental is surprised to recognize in the language itself, the meaningful designs wrought by the Chinese in jade have become one of the world's most richly endowed artistic forms

(Left) THIS BEAUTIFULLY proportioned receptacle was used as a wine pot in the Ming period (A. D. 1368-1644), Golden Age in the history of Chinese art. Like many examples of the virile and enduring art of China, this object is guarded over by the *shou* mark, symbol of long life—in this instance a rare variation of the design. (Drummond Collection)



(Above) TWO PENDANTS of the Ch'ing period carved from white jade, with circular variations of the *shou* mark. (Drummond Collection)

To trace the origin of the written language of China we must go back into the legendary past of this ancient people and follow the development not only of the written characters but also of their engraved equivalents.

The earliest type of these characters, like the hieroglyphics of Egypt, were pictograms, rough drawings of objects—a tree, a man, a bird, and so on. But, as Herrlee Glessner Creel points out,* although this earliest known Chinese writing contained many words that are obviously pictures, the writing itself is not picture writing, nor is it crude or primitive. The details of a system of writing may be altered so that the symbols are changed beyond recognition, but the system itself approaches perfection. Such an approach to perfection in Chinese had already been made by the writing system of the Shang period (B. C. 1766-1122).

Subsequent modification and combination of the Shang characters followed with the growth of the language. Whereas the "oracle bones" of the Shang dynasty were engraved with characters that numbered at most 2500, the Chinese of today use upward of 70,000 characters. This development, which began in the Chou period (B. C. 1122-249), includes in addition to the original pictograms at least three new sorts of characters: (1) Symbols expressing concepts without shape (Indicators). These represent such relations as *central, above, below,* etc. (2) Composite characters that express an idea. Thus the symbol for "brightness" is made by combining the pictograms for the sun and the moon. (3) Compound characters in which the more important element simply represents a spoken sound (Phonograms). The sound may express several meanings, and the specific meaning intended is determined by the pictogram used with it.

In the hands of such a people as the Chinese, whose sense of symmetry and balance is obvious in all of their art, the rude pictograms of their early writing became conventionalized into a calligraphy of graphic beauty, whose decorative possibilities can hardly be exaggerated.

Early in this process of evolution was developed the form of writing known as the "seal" characters.

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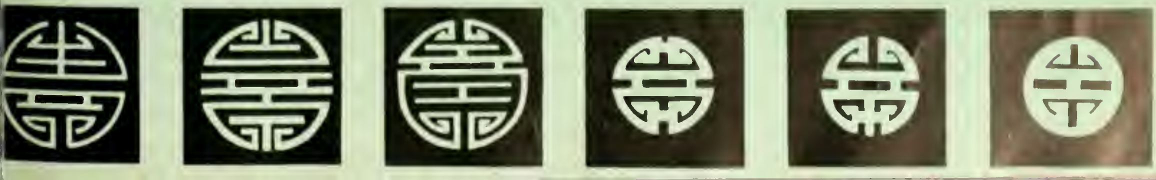
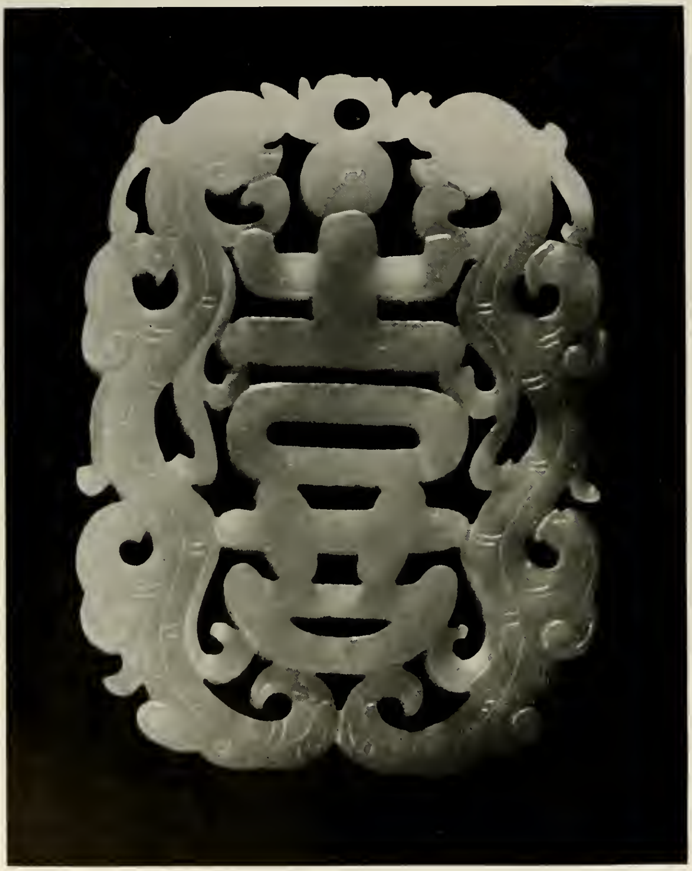
*See *The Birth of China*, p. 159



(Below) THE HAPPINESS character, supported by two dragons, is here carved in the form of a pendant of white jade. Ch'ing period. (Whitlock Collection)

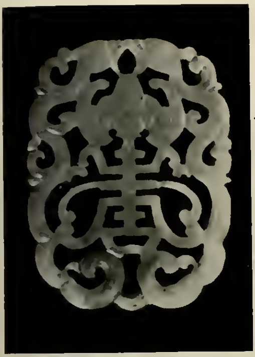


because they were used in inscribing seals, notably the famous Imperial Seal, made for the Emperor Ch'in Shih Huang in 246 B. C. As cut for inscriptions on jade seals, these characters were presented in relief and in reverse, so as to furnish a clear and legible imprint. They were also used for incised inscriptions on such jade pieces as the *kuei* (scepter of authority) of the Han Period.

Because of the fact that the beauty and balance in their design make them highly decorative, the seal characters have been extensively used by the modern Chinese carvers of jade for inscriptions, in much the same way as modern Occidentals use black letter or Gothic type to print ornamental notices or to engross diplomas or certificates. When seal characters are employed in this way they are almost invariably carved in relief.

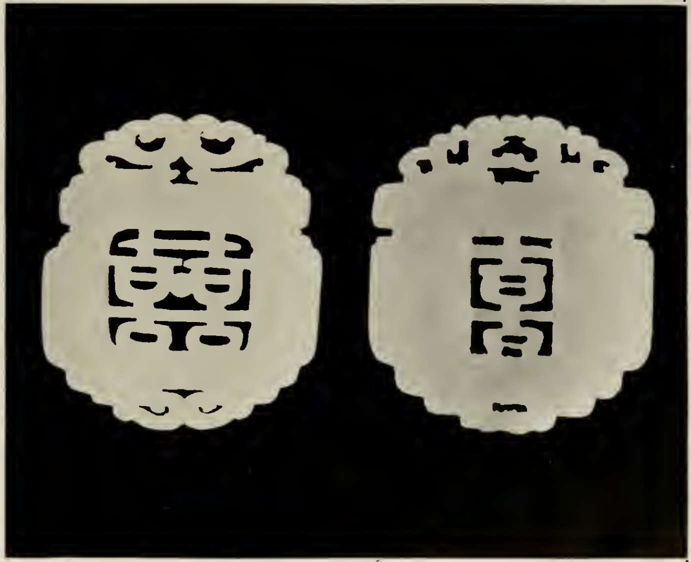
From ancient times the Chinese race has been characterized by a love of ceremonious formalities, such as the presentation of gifts which express auspicious wishes. Several of the characters that signify such wishes, such as long life, happiness, wealth and felicity, have been carved in jade to form pendants to be attached to the girdle or worn on a knotted silk cord around the neck. These jade pieces, which are, of course, less perishable than the same characters painted or stamped on paper to be attached to doorways, are often highly ornate. The chosen character has been conventionalized almost beyond recognition.

The character expressing long life or longevity is especially popular and is said to have over 100 variations. Starting from the character as written to express long life, we are able to follow successive forms, each more conventionalized and balanced than that from which it was derived, until we come to the cir-

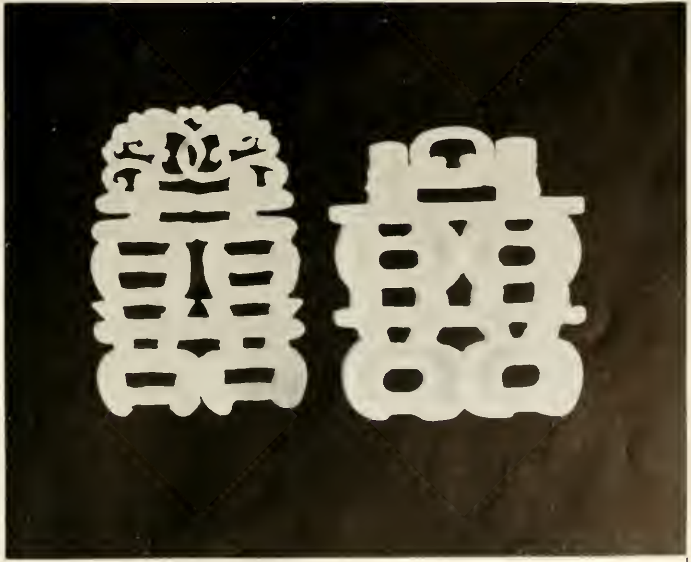


(Left) A BAT hovers above the symbol for Happiness in this Ch'ing period pendant. Dragons again form the frame. (Whitlock Collection)

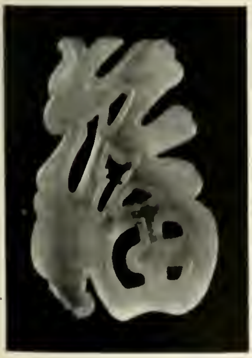
(Right) DOUBLE HAPPINESS is symbolized in the left-hand pendant by duplication of the sign used singly in the piece beside it. Ch'ing period. (Whitlock Collection)



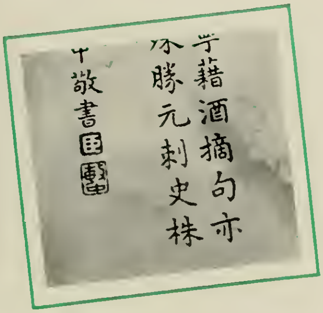
(At right) DOUBLE HAPPINESS is expressed simply, without the usual ornate border. Ch'ing period. (Whitlock Collection)

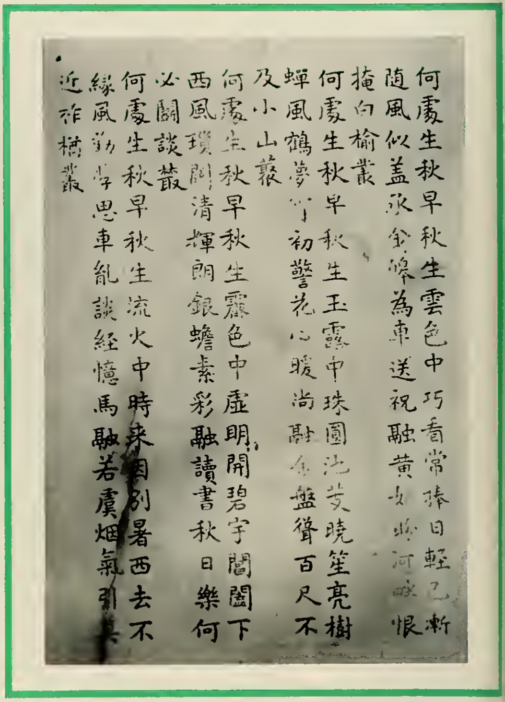


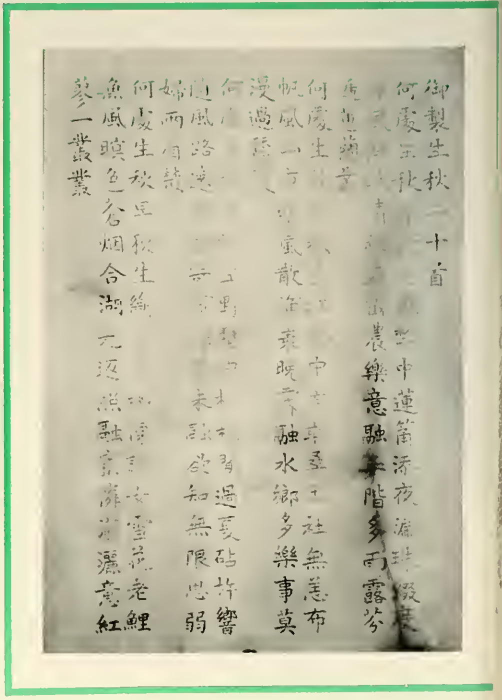
THE SMOOTH lustrous texture of white jade gives unusual beauty to the symbol for Good Luck as carved below in a pendant of the Ch'ing period. (Whitlock Collection)



THE SIGNATURE of the Emperor Ch'ien Lung appears at lower left in the tablet below. At right are shown both sides of another similar tablet engraved with the Emperor's odes, which are translated opposite. (Drummond Collection)







cular variations that only vaguely suggest the original written version. Some of the elements in this evolution are shown in the drawings on pages 108 and 109, which represent the carved symbols as studied from actual pieces. Sometimes the circular version of this *shou* mark is used as the center of such a design as "The Five Happinesses," or it is made the rallying point of other auspicious symbols.

The character signifying happiness is almost as universally used as the *shou* mark, but since, unlike the latter, it has no circular variant it is not so adaptable to a symmetrical balanced design. In fact jade pieces carved with this character are seldom otherwise decorated. The happiness character is, however, frequently doubled by uniting two single characters placed side by side. The resulting design is known as "Double Happiness," and is frequently given as a wedding present or as an accompaniment of a present made to a bride.

The character that means good luck, although often carved as a plain pendant in jade, is also sometimes made the center of a design composed of bats, butterflies, and many other auspicious symbols. It is also much used in its seal character variant in the combination known as *ta chi* or "great good luck." The *ta chi* in raised characters is often to be found either on tablet pendants or on conventionalized representations of gourds.

Other characters in frequent use are those that express Wealth, Riches, Eternal Prosperity, Virtue, Honor, Rank, and Congratulations.

Perhaps the best examples of the decorative use of both script and seal characters are to be found in the various inscriptions on jade pieces carved to perpetuate the short Chinese poems known as odes. A very noted example of this characteristic writing is contained in the odes composed by the Emperor Ch'ien Lung and engraved on jade tablets by one of his court officials. Two of these tablets are among the treasures of the late I. Wyman Drummond. One of them, depicted at the head of this column, bears the signature of the Emperor Ch'ien Lung in the lower left-hand corner. The other, engraved on both sides with odes, is illustrated at right, with a translation for which I am indebted to Mr. Yu Ming Chung.

Odes to the Coming of Autumn

By His Imperial Highness, CH'IEN LUNG

Where does Autumn come early?
It comes in the heart of the Imperial Palace.
At night lotus leaves begin to curl,
With a pearl garment to resist the cold wind.
It is pleasant to attend to state affairs in blue clothes;
It is pleasant to observe agriculture.
The jade staircase is covered with rain and dew,
While fragrance comes from the orchid trees.

Where does Autumn come early?
It comes in the heart of the road along the river
Where sacrifice is being offered at the altar of Earth,
Not for the spread of wind to push the sail,
But for a soft breeze that envelops hills and towns.
The fisherman's garment is gay in the twilight,
Where pleasant events abound in the village;
So do not pass the mulberry bushes in haste.

Where does Autumn come early?
It comes in the heart of a rustic village,
Where water baskets have leisurely spent the summer,
And the sound of the pounding of grain echoed in the wind.
The road is long and a letter hard to reach;
The right is deep but dreams never sound
To understand the boundless thoughts.
Just look at the brows of the weak lady.

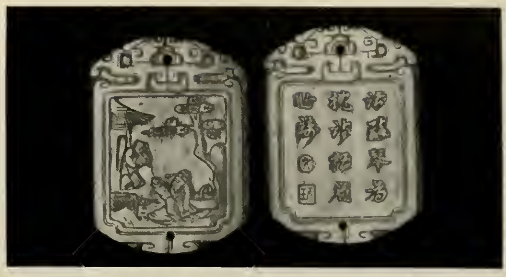
Where does Autumn come early?
It comes in the heart of a broken river bank.
The willows are scattering cotton like snow;
The flowers are fading and the wind rising;
The twilight dissolves into the dark vapor
Which reflects peacefully on the lake.
It is most pitiful to experience the sad feeling
With the appearance of the red bushes of smart weeds.

Where does Autumn come early?
It comes in the heart of a piece of colorful cloud
Which looks artfully as if always holding the sun
And sailing lightly and slowly with the wind,
Like a roof filled with golden radiance,
Like a chariot carrying the Sun God.
The yellow ant is grazing on the river bank
And sadly hiding herself among the white elms.

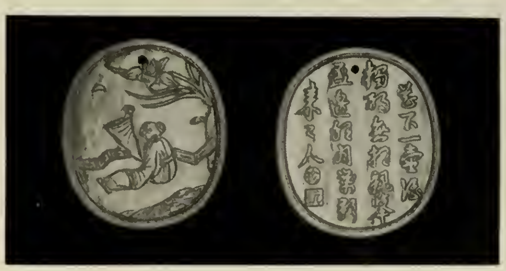
Where does Autumn come early?
It comes in the heart of a drop of dew-like jade,
A pearl that brings morning to the pond weed on the pond.
Clear as a pipe, a cicada is singing on the treetop,
While a crane is still dreaming at dawn,
Warm and tender still is the flower's heart.
The golden foliage towers a hundred feet high
But has no rivalry to the bushes on the little hill.

Where does the Autumn come early?
It comes in the heart of a twilight
Which spreads faintly yet clearly over the sky.
The autumn is over-powering the western breeze,
Bringing purity, radiance, and brightness to the tiny door,
While silver rays lend colors to the rising vapors.
It is pleasant to read in an autumn day;
Why should we waste our time in idle talks?

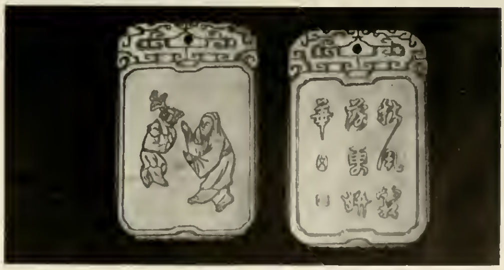
Where does Autumn come early?
It comes in the heart of a flowing fire,
Which often flames with the departing summer
And moves westward without the wind.
Hard studying reminds one of Chê Yin;
Classic discussions recall Ma Yung.
If the temptation of the misty vapor is irresistible;
Do not approach the trees of hawthorn.



THE INSCRIPTION above, translated by Mr. Yu Ming Chung, reads: "When autumn wind blows and the frost falls, [the landscape] becomes more beautiful."

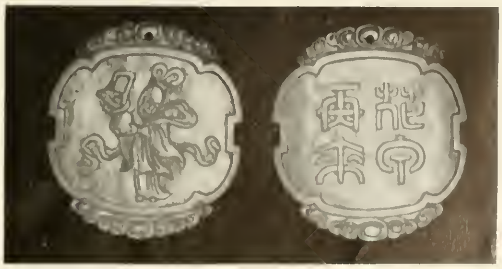


RAISED CHARACTERS are typical of the small tablet pendants shown here and on the following page. The tablet above reads: "I make my lute my pillow, tending the stones which can speak."

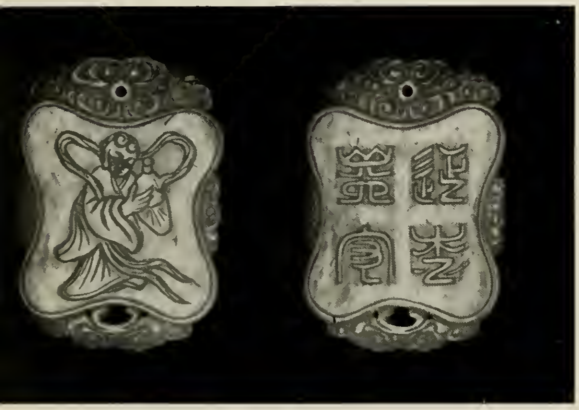


(Above) "WITH a pot of wine, under some blossom tree, I drink alone with no relatives around, holding up the cup to invite the bright moon. Let no one come to disturb my peace."

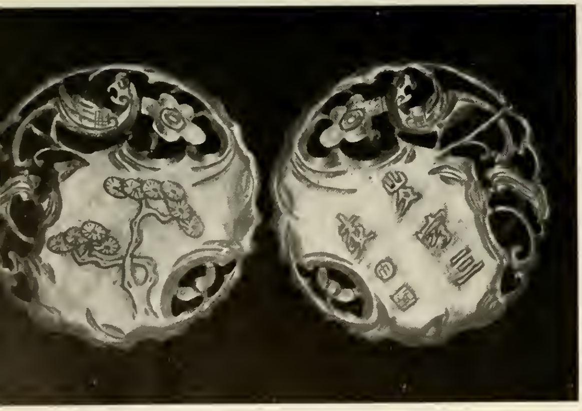
Below at left is depicted the immortal street singer of China, Lan Ts'ai-ho bearing aloft her basket of flowers. The obverse side bears the appropriate inscription: "Flowering trees return again."



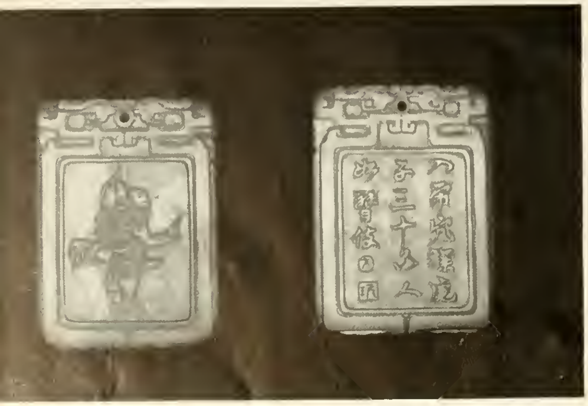
The tablet pendant below, engraved with a lotus motif in low relief, carries the inscription: "Peace engenders long life."



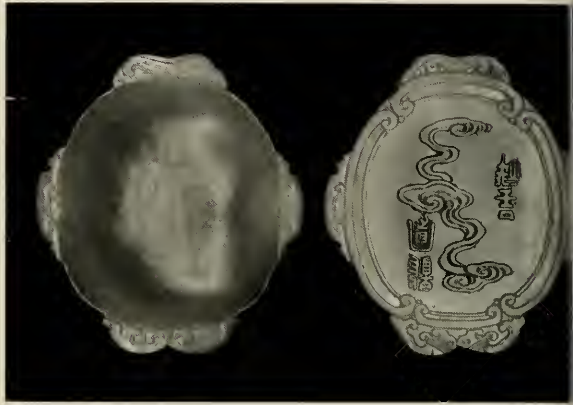
The inscription below, "Three Companions of the cold season (winter)," refers to Buddha (indicated by bamboo), Confucius (the pine), and Lao Tzu (the prunus blossom)



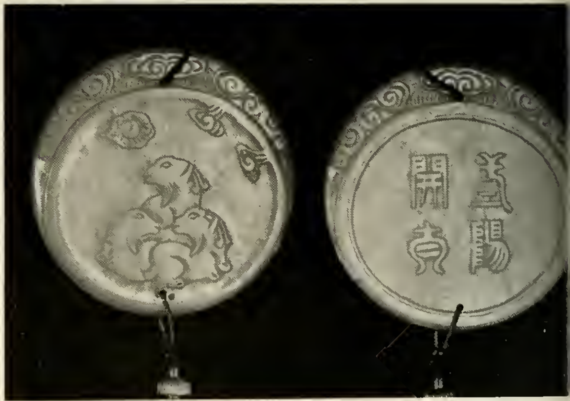
(Below) "I lead a band of thirty hunters to hunt the forest for flesh-eating tigers."



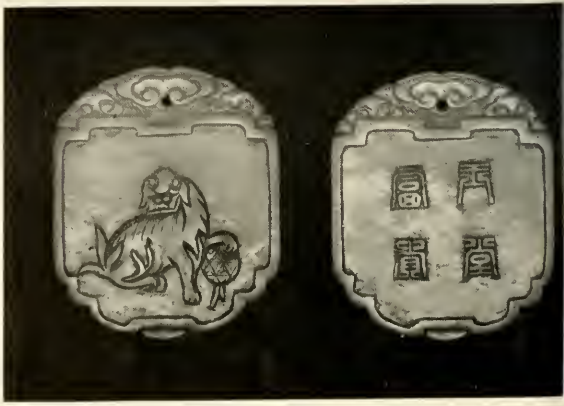
The tablet below is in the form of a beautifully wrought hand-rest, which allows the hand to glide smoothly along when writing. The inscription on the underside reads: "Dragons and phoenixes are auspicious creatures."



Three sheep *(below)* which enabled a famous warrior to escape from prison gave rise to the accompanying inscription: "Propitious sheep open the universe."



(Below) A fu lion counterbalances the inscription, "Riches and honor in the jade hall." Thus in many artistic forms, Chinese artists express their ancient philosophy



GIANT FISHES OF NORTH AMERICA

Titans such as the average angler envisions only in the most golden of his dreams come to light when we examine the records of the Oregon sturgeon and the alligator gar

By E. W. Gudger
*Honorary Associate in Ichthyology,
The American Museum of Natural History*

The question perhaps most frequently asked of us in the Department of Fishes in the American Museum is, "What is the biggest fish?" To this my stock answer has been, "The whale shark is the largest fish in the world." But occasionally the query comes, "What is our biggest fresh-water fish?"

The question cannot be answered offhand. For years I have had it in mind to dig up the evidence and answer it. But the task is large. The information is widely scattered, thoroughly hidden in technical works or in books of travel, and hence is to be gathered only with much work (digging is a good word), and good illustrations are almost nonexistent. Then unfortunately most writers content themselves with saying, "Grows to large size." Or they merely state, "Said to reach a length of twelve to fourteen feet"—without giving the authority. Every effort has been made to verify the sizes and weights given herein.

The question of what are the largest fishes will have to have several answers since there are many more than one candidate for the distinction. To set forth the sizes of these great fishes will call for all the big fish stories that I know, and the reader had better get into his "dugout" and stay there until the big-caliber fish-story barrage is over. And like "Old Bill" in World War I, if the reader gets tired and knows of a "better 'ole," let him "go to it."

But before I begin my big-fish tales, let me pray the prayer of the ardent fisherman of today as well as of him who wrote it hundreds of years ago:

> "Lorde, on a somere's Daye,
> Wyth an Hook and Angell,
> On Grassie Swarde I laye,
> And inn plashyngge Waters dangell.
>
> "Lord, suffer me to catch a Fyshe
> So large that even I,
> When talkyngge of it afterrwardes
> May have no neede to lye."
>
> *Angler's Prayer*

The term "big fish" is a relative one—as in the case of the one that got away,—relative to the fisherman's excitement and the listener's credulity. But there are in North America two unquestionable giants of the piscine world, the White or Oregon Sturgeon of the rivers of the Pacific Northwest and the Alligator Gar of the Mississippi and the other rivers flowing into the Gulf of Mexico. Interestingly enough these fishes are both members of one of the "first families" of fishes—the Ganoidei. The ganoids (from the Greek word *ganoin,* meaning shining) have large heavy scales with an outer layer of shining enamel or ganoin. They are at least partially clad in armor as the photographs will show.

The White or Oregon Sturgeon

Found in the Columbia and Fraser Rivers of our northwest Pacific drainage, the white or Oregon sturgeon is the largest of our American sturgeons and the largest of North American fresh-water fishes for which there are definite records. This giant bears the scientific name *Acipenser transmontanus. Acipenser* was the Greek name of a fish much esteemed by the ancients—perhaps a sturgeon—while *transmontanus* means across the mountains (the Rockies)—that is, western.

Of the Oregon sturgeon, Jordan, Evermann, and Clark say in their *Check List of the Fishes. . . . of North and Middle America* that it is, "Largest of the [American] sturgeons, reaching a weight of 1000 pounds. A record specimen taken at Astoria [at the mouth of the Columbia River, in Oregon] weighed 1900 pounds." Then they add, "Once abundant, now nearly extinct." And it may be said further that they are doomed to sure and swift extinction in the Columbia River with the building of the great Bonneville hydroelectric dam across the river.

I have sought in vain to verify this 1000-pound weight. Clark, the only surviving author, can give no authority for it, nor can any of my correspondents in Seattle and the Columbia River country. However, as a result of this correspondence, some most interesting photographs and facts have come to me. All these will now be set out.

Through the courtesy of Dr. L. P. Schultz, Curator of Fishes in the U. S. National Museum, I present the photograph at right. The fish shown was taken at the mouth of the Fraser River, British Columbia, the date not recorded. The fish measured 10 feet 6 inches in total length and weighed 1015 pounds. It is a veritable giant. Note the row of huge ganoid scales down the back, and that of smaller scales on the side.

Doctor Schultz has kindly sent me the record of a longer but lighter sturgeon taken in the same locality in May, 1931. It was a female measuring an even 12 feet "over-all." Fresh from the water, it weighed 800 pounds, but when dressed, its weight shrank to 692 pounds. Part of this loss is accounted for by the 50 pounds of roe, which were made into caviar.

In the next photograph is seen Mr. L. J. Farley, of Prosser, Washington, standing beside his colossal sturgeon. This was taken at the mouth of the Yakima River, a northern affluent of the Columbia, at the point where, after flowing south, the Columbia turns west to the Pacific. This fish measured 11 feet 6 inches over-all but weighed only 826 pounds. It was caught on a setline hook baited with lamprey eel—a rather unusual bait one would think for a sturgeon. Mr. Farley writes that he has heard of a 12-foot white sturgeon weighing 1100 pounds taken from the Yakima River some years earlier. Of this he unfortunately had no photograph.

Mr. A. B. Chapman, of Seattle, Washington, sent me a photograph of a huge white sturgeon lying on the ground. This photograph was, I regret to say, not suitable for reproduction. The fish was taken from the Columbia River at Kalama, Washington, near where this great river turns west to run into the Pacific Ocean. It was a female, 11 feet 6 inches in total length. It was the same size as the preceding fish but slightly heavier—835 pounds. The roe weighed 90 pounds and was sold for $90. The total return of this fish to the fisherman was about $150.

The information on the next and largest Oregon sturgeon on record was sent to me by Dr. Wilbert M. Chapman of the Fisheries Laboratory of the University of Washington, Seattle. He had the facts from his father, Mr. A. B. Chapman. This great fish was captured in the Columbia River at Vancouver, Washington. It was taken in May or early June, 1912, rolled up in a salmon net after the fashion of a netted shark. This giant was a female, 12 feet 6 inches long, weighing 1285 pounds—of which the eggs accounted for 125 pounds. And, curious to note, the weight of the head was also 125 pounds. Mr. Chapman saw, measured, and weighed this fish. He had it photographed, but the photograph, most unfortunately, got lost. Mr. Chapman affirmed that this was the largest sturgeon taken in the lower Columbia during all the years when big fellows were being caught.

This 12½-foot, 1285-pound sturgeon is the largest Columbia River and Pacific Northwest fish of which there is definite record. It is a grievous loss that the photograph of this colossus among American sturgeons is not available.

However, huge as is this 12½-foot 1285-pound fish, there is a legend of one still larger. This legendary one "is said" to have been caught near Astoria in 1892, to have weighed 2000 pounds, and to have been preserved, mounted, and exhibited at the Chicago World's Fair in 1893. Diligent inquiries have brought no definite information; the huge fish seems to have vanished into thin air. Probably it is the one referred to by Jordan, Evermann, and Clark.

Doctor Chapman writes me that the days of these giants in the lower Columbia are over and gone, that even as late as 1934 one had to go far up the river to the region of the mouth of the Snake River to catch one as heavy as 500 pounds. This particular sturgeon goes far up in fresh water to breed, but seems to spend much of its life in salt water and there attains its growth. But with Bonneville Dam lying athwart the Columbia, with its salmon-sized fish ladders blocking the ascent of these large breeding fish, and with intensive fishing in the lower river, the day of the great Oregon sturgeon is over. How are the mighty fallen!

Huge as are these sturgeons, and as much food as they require to keep their great engines going, they are not predators. The round suctorial mouth devoid of teeth forbids this appellation. This mouth is under the head and is a protrusible spout-like structure. With it, the sturgeon gathers in small fishes, crawfishes, and smaller crustaceans, insect larvae, mollusks, and other dwellers on and in the muddy bottom. But when one considers the great size of this West Coast sturgeon, one wonders how it can get all the food of this kind that it needs to grow so large and to navigate when grown.

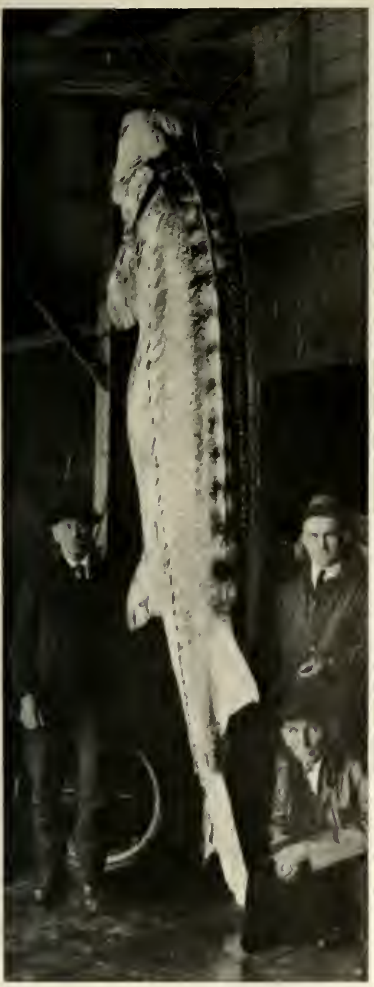
This sturgeon is a fish of very considerable economic importance in the Northwest. Its flesh is eaten, and from the huge ovaries of the female the thousands of eggs are taken and converted into caviar. The air bladders are made into isinglass. The extinction of this great fish will be a very considerable economic loss to the people of the Columbia and Fraser Rivers and of the adjacent country. The same is true of an eastern sturgeon once abundant in the Delaware and Hudson Rivers. Along the Hudson, its flesh was formerly in great demand under the name "Albany beef." Through overfishing, this eastern sturgeon is now practically extinct.

The Alligator Gar

The alligator gar, formidable ganoid of the central basin of the United States, is, as the reader will presently see for himself, the most interesting fresh-water fish of our country. It is the unchallenged ruler of the Mississippi River and its tributaries and of the other rivers flowing into the Gulf of Mexico. It is clothed with a coat of mail made up of imbricating or overlapping scales composed of an inner layer of bone and an outer one of shining enamel or ganoin. The scientific name of this armor-clad medieval knight is *Lepidosteus spatula,* a composite name denoting its bony scales and spade-shaped snout. The appropriateness of this title for this great fish is evident from a study of its photograph.

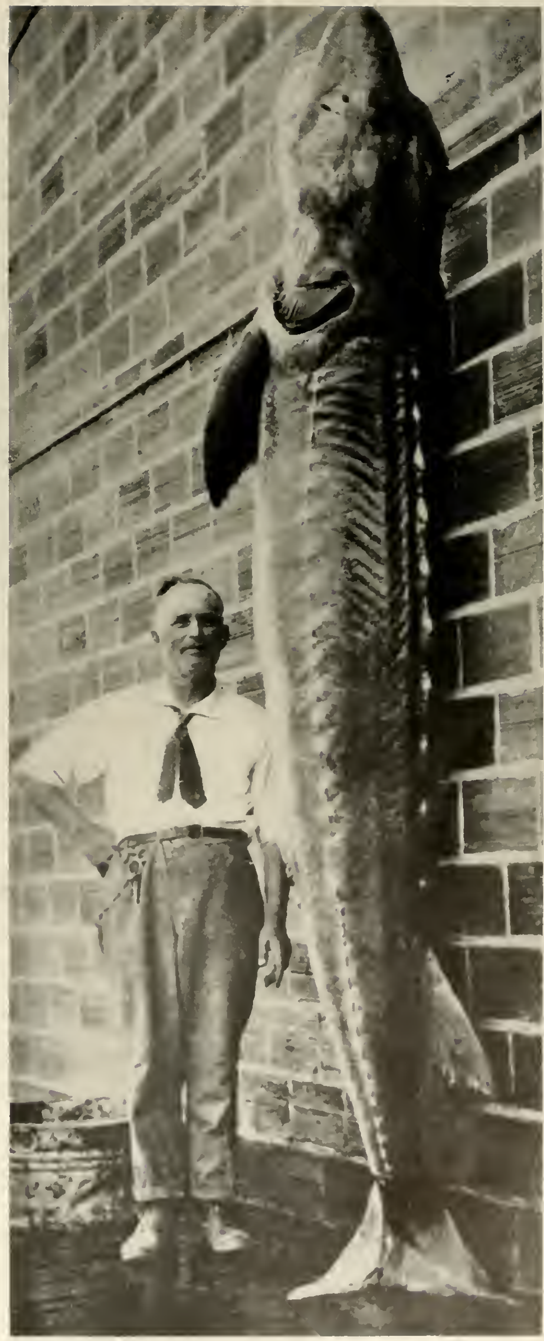
As to the accuracy of the appellation "alligator," I can give the following personal experience. Forty-three years ago, on the Bryson Place, ten miles below Little Rock, Arkansas, I walked around a point of land on an old oxbow "cutoff" or bayou of the Arkansas River and came in view of a 6-foot gar of this species lying on the shore head on to me. Recoiling, I ejaculated to my companion, "Look, an alligator!" The illusion was perfect. Earlier in the day, it had been taken in a seine by fishermen, killed, and left on the shore. I know of no fish with a name so aptly given. Its heavily scaled body and broad, short, blunt (spade-shaped) snout surely produce the illusion noted in my case.

The alligator gar is the largest fish found in the great central valley of the United States. Years ago I began the preparation of an extensive treatise on the natural history of this armored giant. However,



Courtesy of Dr. L. P. Schultz

(Above) Two feet and 270 pounds short of the record: a gigantic Oregon sturgeon from the Fraser River. This fish tipped the beam at 1015 pounds and measured ten and one-half feet



Keystone View Company

Closer to the camera, this colossal sturgeon caught by Mr. L. J. Farley seems to dwarf the one at left. It is a foot longer but 189 pounds lighter. The Oregon sturgeon is doomed in the Columbia River by the erection of the Bonneville Dam the great financial depression in 1930 made impossible its publication, so the work was never completed. From that paper I extract the following highlights.

Rafinesque, that strange Sicilian genius, first described this "formidable fish." He states that "it reaches a length of 8 to 12 feet, and a weight of 400 pounds [he did not know any better], and preys upon other fish, even Gars and Alligators. Mr. John D. Clifford told me that he saw one of them fight with an alligator five feet long and succeed in devouring him, after cutting him in two with its powerful jaws. [Perhaps another reason for naming it alligator gar] . . . These jaws are from 12 to 18 inches long."

And David Starr Jordan (who ought to have known better) went Rafinesque 8 feet better and says that his fish reaches a length of 20 feet or more. Others, more or less from hearsay (either by word of mouth or in written communication) say that the alligator gar attains a length of 12 to 14 feet today,—but I doubt it. As the late Doctor F. A. Lucas used to say, "All fishes shrink under the tape measure." Still it is possible that in lower Arkansas, Mississippi, and especially in Louisiana (in regions little fished), such monsters may have lived in earlier days. But prolonged fishing and hunting (for this big gar has been literally hunted with bow and arrow, with shotgun and rifle) have killed off the big fellows.

From Arkansas, I have the following authentic records. The late Louis Reitzammer, my most valuable correspondent, at Arkansas City on the Mississippi River, sent me these: (1) 7 feet 4 inches long, 43 inches in girth,* 154 pounds on the scales; (2) 7 feet 5 inches long, 49 inches in girth,* 163 pounds weight; (3) 7 feet 6 inches long, 32 inches in girth, 186 pounds weight.† Then he added, "You need not be surprised at accounts of 10-footers. I am satisfied that we have them here that large, but we have not been successful in landing them."

The next fish were taken but two miles away from where I saw my "alligator" and in the same system of "cutoffs" from the Arkansas River. My former student, the late Dr. Henry Thibault, caught two big fellows near his home. Here are his figures: (1) 7 feet 8 inches long, 178 pounds in weight; (2) 9 feet 2 inches long, 232 pounds in weight. This latter is next to the largest fish of which I have been able to get an authentic record. It can be relied on, for the man who made it was one of the most meticulous persons I ever knew. He wrote me that the head alone measured 2 feet long. And in the same locality, my friend J. R. Alexander measured a head that was 12 inches wide between the eyes.

As might be expected, the alligator gar grows large in Louisiana. Percy Viosca of New Orleans, who knows the natural history of Louisiana animals as perhaps no one else does, has sent me a number of unverified accounts of huge specimens taken in those waters. One says that our gar grows "12 or 14 feet long and to several hundred pounds in weight." Another man notes that "it attains a length of 12 feet and weighs over 200 pounds." A third correspondent speaks of the catching of specimens 8 to 10 feet long, and of the killing of a 200-pound fish. Another account is of a 7-foot 8-inch specimen weighing 321 pounds—a weight entirely too great for the length. These accounts must be taken for what they are worth. Both Viosca and I think that these men caught unusually large gars, but we doubt if all of them actually measured and weighed their fish.

Dr. C. H. Townsend (formerly Director of the New York Aquarium) went years ago to Calcasieu Parish, western Louisiana, to study the alligator gar. While there he was the guest of Mr. Henry D. Whiton, of New York City, who had extensive business interests there. He went there several times a year and knew everybody in the parish. Mr. Whiton was very much interested in these large fishes. Doctor Townsend reported as follows: "Mr. Whiton furnished a record of a 12-foot specimen killed in Lake Calcasieu and measured by M'sieu Tata Ibert. He [Mr. Whiton] saw the broken remains of the fish and says that it was so much larger than any of the 8-foot gars known to him, that he accepted M'sieu Ibert's statements."

If Doctor Townsend had only seen and measured this giant (for giant it surely was) or had gotten and measured the lower jawbone, we would have an authentic record. From examination of a number of specimens, I have found that the lower jawbone, measured in a straight line from the front center of the jaw to the angle at the rear, closely equals about one-ninth the total length of the fish.

Viosca thinks that about 9 feet is the maximum size for those in the bayous of his state today. Mr. E. A. McIlhenny, of Avery Island, Louisiana, who has had long and intimate knowledge of our great fish, writes that in the great drought of 1925, he visited an inland lake that had gone nearly dry. He "put the tape" on 50 big gars and found 30 to measure over 7 feet, but the largest was only 7 feet 7 inches. The largest he has ever seen was taken in Belle Island Lake, Vermilion Parish. This female, which was full of eggs, measured 9 feet 8½ inches in total length and weighed 302 pounds. This and Doctor Thibault's 9-foot 2-inch, 232-pound specimen are the largest alligator gars of which I have found

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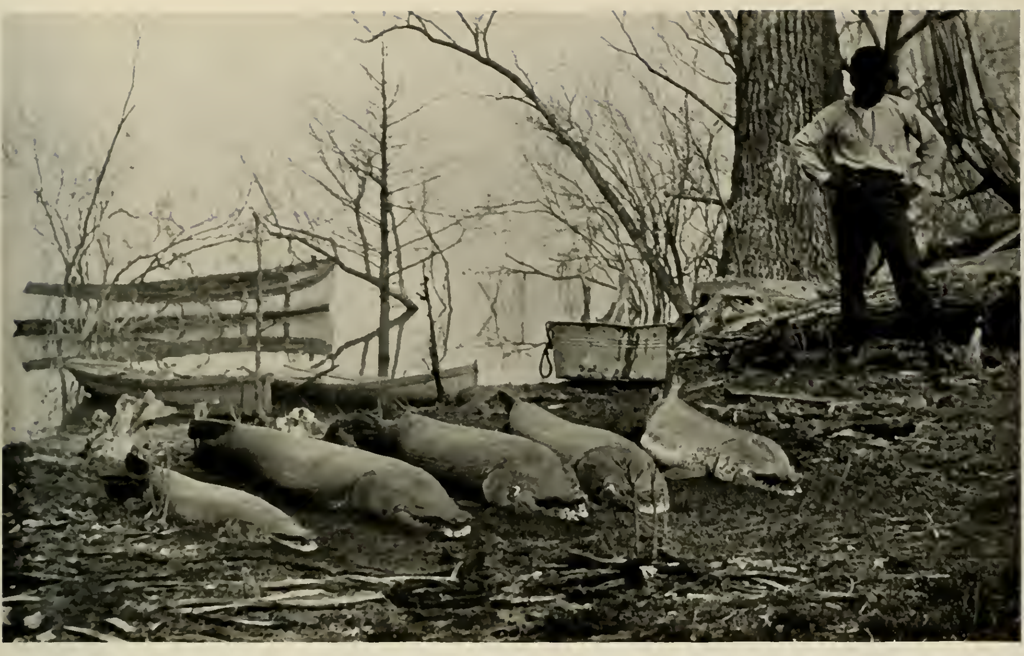
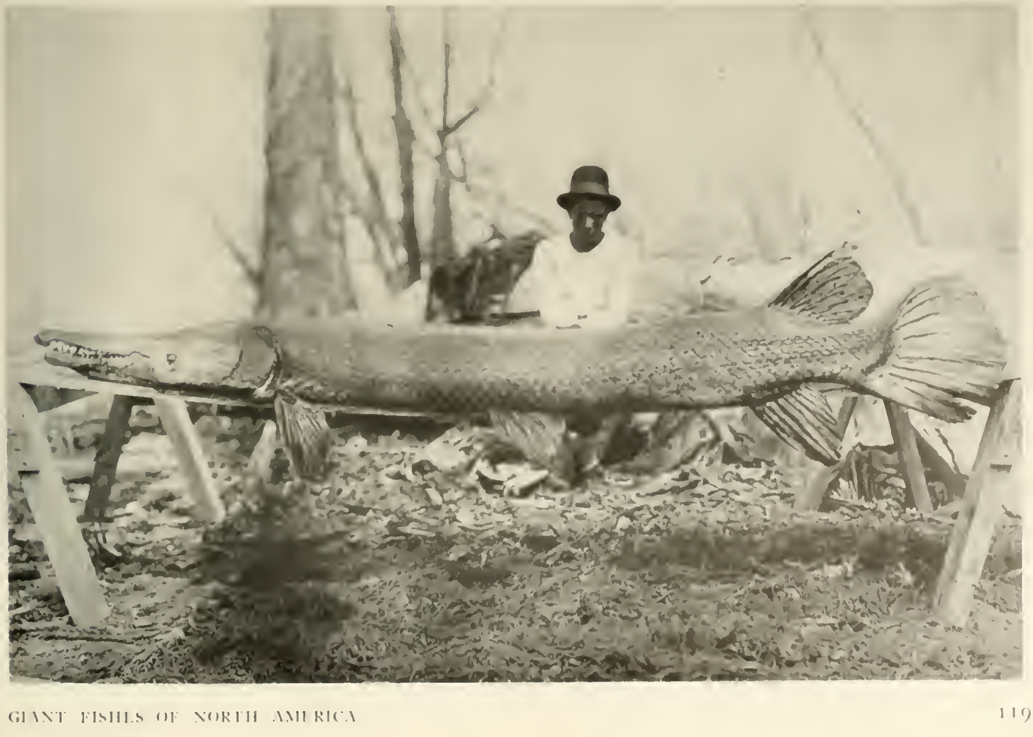
* Extraordinary girth said to be due to gases generated in the dead fish in the hot sun.

† The ovaries filled with eggs accounted for 22½ pounds of this.



The largest fish in the Mississippi Basin, the alligator gar, receives its name from its head-on resemblance to a 'gator. Unlike the sturgeon, the gar makes poor food. The eggs are not only useless as caviar but actually poisonous. These specimens were caught in Moon Lake, Mississippi, in 1910. The lanky gar below may not have fed in some time. Gars have dreadfully large mouths and sharp teeth and are voracious eaters. The record length is 9 feet 8½ inches, the record weight 302 pounds, though unofficial measurements exceed these figures

Photographs by Dwight Franklin



authentic records. These are reliable and may be accepted.

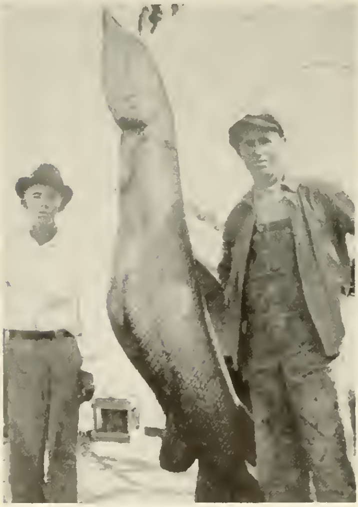
It is plain that this huge fish must be a "heavy eater,"—and especially is this true of females at the approach of the breeding season. The size of the food to be ingested may be inferred from the huge gape of the mouth and the size of the dental apparatus. This is shown in the accompanying photographs. I know of no fish that has such long and powerful jaws filled with such huge canine teeth. Manipulations indicate that the vertical gape quite equals the length of the jaws. Our fish is plainly a predator. Its requirements and its size of mouth and shape of teeth indicate that it swallows its prey whole or at any rate in large fragments. Rafinesque says that one of them caught a young alligator and bit it in two, and swallowed the fragments. Others have alleged that it fights, conquers, and eats alligators. Hussakof in 1914 dissected a 6-foot 6-inch specimen and found in it a long-nosed gar pike, 2 feet 2 inches long, which the cannibal had engulfed head foremost. But the favorite food of *L. spatula* is the more digestible common fishes. Mr. Reitzammer's 163-pound specimen previously mentioned had in its stomach about 40 pounds of foodstuff, half of which was recognizable—12 crappies, a buffalo fish, and a catfish.

But here follows the prize account of the enormous voracity and capacity of the alligator gar. Below you see a picture of a 7-foot fish taken at Progresso, Texas, which allegedly weighed "more than 300 pounds." It had a huge and protuberant abdomen, and when dissected, the cause for this aldermanic appearance was explained—it contained 52 pounds of various kinds of fishes. These were intact and the count—7 catfishes (34 pounds) and 6 fresh-water drum (18 pounds)—gave the weight as 52 pounds. The alligator gar is known also to catch and eat swimming ducks, and other small swimming animals.

Does it attack humans?

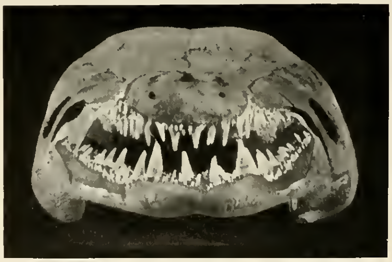
When one looks at the gaping mouth and huge canine teeth of our great fish, one is almost sure to ask, "Does the alligator gar attack man?" Now this mail-clad monster is not only an omnivorous predator, but scavenger as well. And the answer is that his scavenging propensities lead up to a habit that surely indicates such attacks. Throughout the territory in which our giant is found, fish docks are a part of the watery landscape. These are often mere rafts of logs spiked to stringers with a rough flooring and a covering shed, and boxes float alongside containing live fishes. From these the customer picks out his fish, the dealer cuts off its head and tail, scales and cleans it, and turns the prepared fish over to the customer ready for the pan. The rejectamenta are thrown overboard.

Here also, in an aquatic region having little good



(*Left*) THIS ALDERMANIC alligator gar, which was captured at Progresso, Texas, had eaten 52 pounds of fish

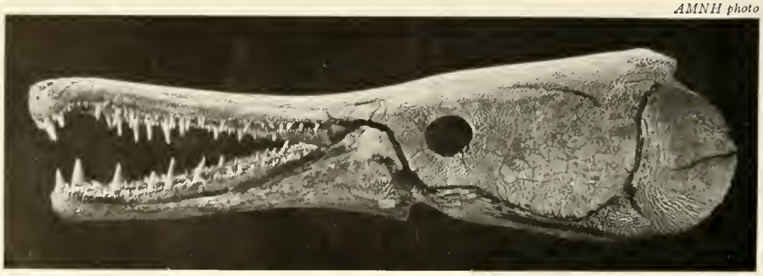
From *Monty's Weekly* (1928), Progreso, Texas



AMNH photo

(*Above*) HEAD-ON VIEW of a huge gar. A human hand or foot caught between these sharp canine teeth could hardly be extracted

AMNH photo



(*Right*) THE ALLIGATOR GAR has more and sharper teeth than an alligator. These jaws have been known to close on a hand carelessly put in the water off the docks where fish are cleaned. But alligator gars probably do not attack swimmers as often as reports would indicate water (cistern water is largely restricted for drinking and cooking) most culinary operations—the preparation of fishes, birds, and squirrels for the pot, and the washing of kitchen utensils—are carried on at these docks or rafts. I have many authentic reports that semitame scavenging alligator gars collect around these docks to eat the offal thrown overboard. Then the inevitable happens, as is attested by numerous accounts from persons in widely scattered localities. Persons with blood and fish slime and fish fragments on their hands dip their hands overboard to wash them, and the gars seize these. One can readily believe that a hand caught between the teeth shown in the adjacent photograph could not be pulled back by the owner without its being badly mutilated, at least. Indeed a large fish with a good hold could easily pull a person overboard—as has happened.

But the reader queries, "Do these huge gars actually attack swimmers?" In answer, the newspapers of the lower Mississippi Valley contain many such accounts. All my attempts to verify these have resulted in failures. The late Doctor Thibault of Scott, Arkansas, wrote me of his total unbelief in such attacks. Once in swimming, he and a big gar bumped into each other. The reaction was mutual—without delay, man and gar each left the scene in opposite directions. "Before I could turn over and start for the shore, I could see the wake of the gar progressing 100 yards up the lake."

Doctor Thibault has had two cases of alleged attacks by gars referred to him for medical attention. One was a boy with deep lacerations on the abdomen. Careful examination revealed the presence of fragments of rotten wood. The boy in diving had struck the end of a sunken and rotten log. The other was a fourteen-year-old girl, with hands, feet, legs, and arms badly scratched in parallel bands. She stated that she had been attacked and nearly drowned, but had freed herself after a desperate struggle. Examination of the site of the alleged attack revealed an abandoned mass of old barbed wire—to which clung some fragments of the girl's red bathing suit.

Percy Viosca and Doctor Thibault both wrote that they have gone swimming in waters inhabited by hundreds of these big fish, without being attacked. Moreover, Viosca has seen men swimming in waters having both fish offal and gars in abundance—and there were no attacks. Perhaps these fish were well fed and possibly wild—that is, more or less afraid of men. While those hanging around fish docks are generally semidomesticated—not afraid of man.

The late Louis Reitzammer was through many years a very careful student of the habits and behavior of the alligator gar. The information sent me over those years checks absolutely with that from a dozen men over the lower Mississippi Valley and the Gulf Coast west to the Rio Grande. Early in our correspondence I had expressed my doubts about attacks on men and urged him to go carefully and skeptically into the matter.

This he did and finally, about two years before his untimely death, he wrote me of a man who dived from a fish dock and had the heel of his shoe torn off —presumably by a gar. Of an attack in June, 1926, on another man, he had personal knowledge and he sent me the duly-attested affidavit of Mr. J. S. Bowles. More than once Mr. Bowles had been hurt when diving—whether by accident or by a gar, he could not say. But this time he felt the fish between his arm and body and was badly cut—two gashes of about 3 and 6 inches long respectively. Mr. Reitzammer was a witness of this attack. "I did not see the fish with its mouth open, but a second after Mr. Bowles screamed, I saw not its entire body but its tail." A hook was baited, and shortly a 5-foot gar was caught. It was possibly the one that made the attack.

* * *

Here is the evidence, pro and con, which I have been able to collect. The alligator gar is an omnivorous carnivore—feeding on animal matter, dead or alive. A heavy, logy fish, a poor swimmer and hence a poor fish-catcher, he is probably hungry most of the time. When hungry, he will undoubtedly grasp a hand or a foot dipped in the water near him. That he will deliberately stalk and attack a human being, as a tiger does, I do not believe. But if a diver comes near a ravenously hungry fish or if the fish is scared or tormented, I can believe that an attack may follow. Personally, I would not care to be placed in the predicament.

Such are some of the facts gathered with much expenditure of time and labor. The habits of the alligator gar need to be studied at first hand by a skeptical scientific observer in the lower Mississippi basin where there are great numbers of this predaceous fish, and over a period of time long enough to get accurate and comparative observations.

The flesh of this great ganoid, unlike that of its large Columbia River cousin, is coarse and rank. It is rarely eaten throughout the lower Mississippi Valley save by the poorest Negroes, and by them generally only in case of necessity. The eggs measure approximately one-eighth of an inch in diameter, and not only are they not made into caviar (as are those of the sturgeons), but they are poisonous when eaten.

TUNGSTEN

Continued from page 97

As prices rise, home production is sure to increase, and modern methods of ore finding here play an important part. The price of tungsten fluctuates widely with changing conditions and is complex for the layman, because the degree of concentration must be taken into account. At current rates, tungsten is valued at over $1.50 a pound by the time the metal is recovered from the ore; but think how thin your light bulb filament is before saving burned-out bulbs for their scrap value!

The American tungsten ore prospects are fairly good, because an interesting physical phenomenon, which mineralogists have played with for years, is now proving to be of great practical value. That is the property of fluorescence, possessed in a marked degree by scheelite, or calcium tungstate,—the principal American ore. Fluorescence is a luminescence shown by certain substances when they are exposed to some of the invisible light rays such as ultraviolet light, X rays, or cathode rays. When ultraviolet rays are thrown on scheelite they are translated in some manner still unknown into visible light, and the mineral fluoresces blue. Indeed, to prospect for scheelite in some regions one needs only to go out at night with portable ultraviolet light equipment and shine it on the rocks. Small traces of this tungsten ore will glow brightly in this light, while most else seems dark and drab. What could be simpler than to mark with paint the brilliant spots and return next day to find the deposits?

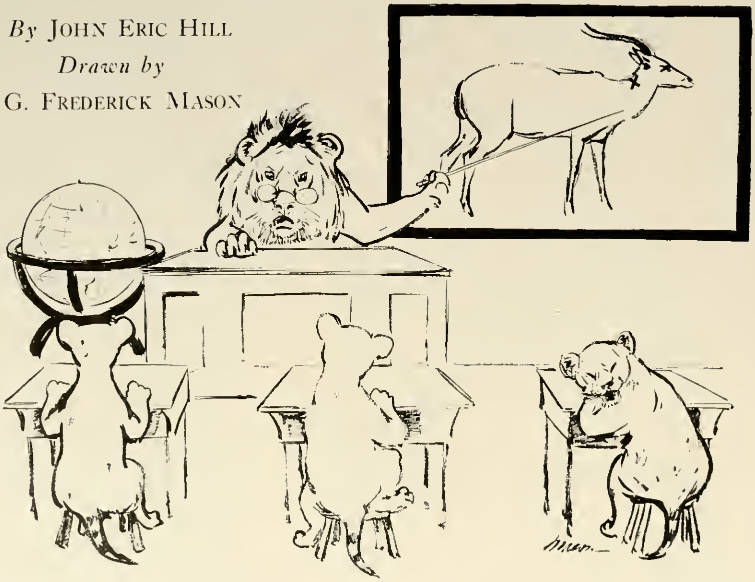
Considerable success has been met with in such ore surveys, and many new prospects for tungsten have been found in this way. Many other uses have been made of fluorescence, but none more valuable than this. Amateur mineralogists, with their seemingly valueless amusements, have rendered a great service in the perfection of portable equipment, and no doubt they have discovered and will discover many new tungsten ore sites. So thanks to them, to the bountifulness of Nature, and to the satisfactory substitutes worked out by scientists, we need not look at our tungsten future with the misgivings engendered by some of our other metal wants.

YOUNG LIONS MUST LEARN

By JOHN ERIC HILL

Drawn by

G. FREDERICK MASON



THE mammals that live by hunting learn more and are less dependent directly on inherited patterns of behavior than the grass-eating kinds, and in the ability to learn, the lion must be nearly or quite the equal of the dog.

The cub is born with a deep-seated hunting instinct. One youngster will stalk and pounce on another or on the twitching tail of the mother, with the same eagerness and thrill exhibited by a kitten. During the year and a half of cubhood this play develops into a hunting and killing technique. Skill comes through long practice, imitation of the old lions, and obedience to warning growls of the mother. Most of their prey consists of large and strong animals, well equipped for self-defense, and a cub's first attempts to kill are made under the watchful care of the mother-lioness. An untrained lion kills by clumsy mauling.

In certain parts of Africa lions commonly prey on the powerful Cape buffalo, while in other areas where this animal exists they leave it alone. Probably the lions that have been brought up by buffalo-killers learn how and carry on the tradition. A failure with such game is generally fatal to the lion.

One reason that most men killed by lions are mauled and die of blood poisoning or shock, rather than suddenly from the lion's customarily efficient attack, is that man-killing is not a common subject in the training of lions. When once they learn how, they can be quite successful, as was shown by the two lions of Tsavo that killed more than 30 men before their careers were ended by Colonel Patterson.

YOUR NEW BOOKS

ALASKAN TRIP ● POLYNESIAN ASTRONOMY ● SNAKE MANUAL
STORM ● TAME GORILLA ● YANKEE STARGAZER ● MILKY WAY
ARCHAEOLOGY OF OUR SOUTHWEST ● WIZARD OF PHYSICS

TOTO AND I: A Gorilla in the Family

by A. Maria Hoyt

Lippincott, $2.50

THE Introduction, by Roger Conant, to Mrs. Hoyt's book is not only an introduction to Toto and gorillas in general but to all the living members of the mammalian order of Primates, or monkey folk of all the world.

Mrs. Hoyt begins her story of Toto with a very realistic account of the Hoyts's hunt for gorillas in French Equatorial Africa. The narrative flows along easily and interestingly. One is not likely to put the book aside after beginning the story, for it holds the reader from start to finish. It is a plain and simply-told record of a remarkable achievement: the rearing of an "almost human," orphaned infant gorilla only a few months old, frail and delicate, which in nine years grew to adulthood with a physique more powerful than that of any man and weighing over 400 pounds.

The author tells, in incident and photograph, of the many wonderful traits of the gorilla, and shows that many of its actions and reactions are indistinguishable from our own. Toto displayed every evidence of affection and concern for Mrs. Hoyt but at times, like an unruly child, would push her or tear her clothing. Such occasions arose only as Toto approached maturity but were to be expected more often as she grew older.

It is clear that Mrs. Hoyt's affection for Toto is very deep and sincere and that she understands the gorilla's every whim. She gives much information, in addition, about the care and treatment of the animal both in health and in occasional sickness. What she does not tell is the great courage she showed in handling Toto when the 400-pound baby was disinclined to obey.

H. C. RAVEN.

CHEECHAKO

by Edgar M. Queeny

Scribner, $7.50

CHEECHAKO can be read for enjoyment and sustained interest, admired for its beautiful illustrations, especially the exquisite color plates, and kept in anyone's library as a permanent fixture.

Mr. Queeny is a sportsman, and his book is the story of a hunting and fishing trip in southern Alaska. He possesses an enthusiastic interest in his subject and an appreciation of so many of the factors which enter into an undertaking of this sort that his book is quite unlike the usual hunting story. The author and his party traveled on the *Westward*, a boat well equipped for these waters and manned by personnel who knew how to explore the natural history resources of such a rich district as southern Alaska.

The itinerary began at Ketchikan and included stops at various places, among them Admiralty and Chichagof islands. The accounts of hunting and fishing incorporate the firsthand experiences of Queeny's party within a background of the extensive experiences of guides and old-timers. The capture of the trophy is a goal, as one would expect, but more than this the reader senses that the chase is just a good excuse to get out into a wilderness and to be ready to drink in impressions.

Photography was a major project and the Kodrachrome pictures used in the book pluck with a nostalgic twinge at the heartstrings of anyone who has seen Alaska, and they should prove a pressing invitation to those who have not had that privilege. I have seen still better photographs than some of those which show bears but, as the author explains, these were taken under trying conditions and the reader may wonder that some of the exposures produced pictures at all.

H. E. ANTHONY.

STORM

by George R. Stewart

Random House, $2.50

THIS is a novel; a novel whose heroine is a storm, a devastating storm that swept down upon the California coast bringing with it a million dollars worth of rain to drought-stricken farmers, and a million-dollar loss and expense to the highway crews, telephone and power companies, railroad and air lines.

On the first day a young meteorologist at San Francisco, studying the Pacific weather map notes a minor low pressure area off Guam. Whimsically, he names the potential infant storm, Maria, and with paternal interest watches her development as she rushes across the ocean toward the coast. On the fourth day a ship is badly battered, and crew members are swept overboard; from the seventh to the eleventh days areas of California are pounded by rains, cloudbursts, or heavy snows. Maria dies on the eleventh day, but a daughter storm, born three days earlier, buffets the Middle West and East with high winds and heavy snows before passing out into the Atlantic area on the twelfth day.

The story of the novel is the story of the storm, of its effects on many people and their reactions to it in various and unrelated walks of life.

According to the blurb on the jacket accompanying this book, the author "spent over two years in collecting the scientific and meteorological data embodied in the story and checked the most minote details with recognized authorities before sending the manuscript to his publishers." Certainly, it does explain the major principles of meteorology accurately, simply, and entertainingly.

As a novel, its merit is reflected in its selection by the Book of the Month Club; as a popular exposition of the major principles governing our weather it is worthy of careful reading. Its value is beyond that of pure entertainment.

H. E. VOKES.

YANKEE STARGAZER,

The Life of Nathaniel Bowditch

by Robert Elton Berry

Whittlesey House, $2.50

HERE is a very readable biography of one of the pioneers of astronomy in America. Nathaniel Bowditch ("the 'bow' rhymes with ship's bow," the author reminds us) is internationally known for his book on navigation, which has for nearly a century and a half been referred to as "the Seaman's Bible." And it is still a best seller on the lists of the United States Hydrographic Office, under the title *American Practical Navigator*.

The life story of this self-educated man is a thrilling and inspiring one. He taught himself mathematics and became, by the age of 22, the foremost mathematician in America. He taught himself Latin in order to read Newton's *Principia*. He spent five years on the *Principia* and, incidentally, found an error in the great work. He taught himself French and later translated Laplace's monumental work, *Mecanique Celeste*. This was more than a translation, for he amplified and explained the more difficult parts of this classical treatise on celestial mechanics.

In 1806 he was invited to take the chair of mathematics at Harvard, but declined. In 1818 President Thomas Jefferson sought to bring him to the University of Virginia to teach mathematics, but he refused. In 1820 he declined to go to West Point, where Secretary of War, John C. Calhoun, asked him to come.

Bowditch was a practical navigator. He made a number of voyages to the Indies, and thus had abundant opportunity to test his *Practical Navigator* while it was in the making. He invented an improved way of "taking lunars,"—a method of finding the ship's longitude, used before the days of chronometers.

His zest for study and his prodigious industry, coupled with a brilliant mind, earned for him many honors, including two honorary degrees from Harvard, the presidency of the American Academy of Arts and Sciences, and membership in the Royal Academy of Edinburgh, in the Royal Irish Academy, and in the Royal Society of London.

CLYDE FISHER.

THE STORY OF THE VARIABLE STARS

- - - - - - - - by Leon Campbell
and Luigi Jacchia

Blakiston, $2.50

THE MILKY WAY

- - - - - - - - - by Bart J. Bok
and Priscilla F. Bok

Blakiston, $2.50

TWO more of the "Harvard Books on Astronomy" have appeared, making four of the nine projected, and these two are up to the high standard set by the first two, which were reviewed in the December number of NATURAL HISTORY.

The Story of the Variable Stars will be welcomed by the host of variable star observers, for the senior author is the dean of professional observers of this class of phenomena, and at the same time he has for many years been the leader in organizing, directing, and inspiring amateurs in the phases of this type of research in which they can do work of value.

Parts of the book are rather detailed for the layman, but these can be left, as suggested by the authors, for the actual variable star observer. But all will be fascinated by the story of the Cepheid variables and their period-luminosity relation,—the best popular treatment of this epoch-making advance in astronomy that this reviewer has read. Another outstanding feature of the book is the story of the novae, the most spectacular stars in the sky.

Besides the short-period variables (Cepheids) and exploding stars (novae), all other types of variable stars are treated in the light of the latest research. Altogether it is an excellent and authentic little volume.

The book on the Milky Way is a stimulating presentation in semipopular form of the history and present status of the exploration of our Galaxy. This great lens-shaped aggregation of 200 billion stars, rotating as a system once in 200 million years, would seem a large order for a small book. But the authors have undertaken the task with enthusiasm, and have finished it in a manner deserving the highest praise.

Our Milky Way was called the Galaxy long before we knew anything about its real structure, or that our sun is a part of the Milky Way Galaxy. The story is told of the unfolding of our comprehension of this vast system of stars, 100 thousand light-years in diameter. The method of measuring its dimensions and that of determining that our sun was not at the center, but between 30 and 35 thousand light-years from the center, are explained. How it was discovered that the Milky Way Galaxy is rotating on its axis at a speed that carries our sun around at the amazing speed of 150 miles a second is clearly set forth.

Some of the other fascinating subjects discussed are: bright nebulae in the Galaxy and why they are bright; dark nebulae; interstellar gas; and the age of the Milky Way.

In a pocket inside the back cover are two superb photographic charts, one of the northern Milky Way and the other of the southern Milky Way. Another feature of the book that should be commended is the inclusion of portraits, scattered through the book, of 30 of the leading astronomers who have added to our knowledge of the Milky Way Galaxy.

CLYDE FISHER.

SOUTHWESTERN ARCHAEOLOGY

- - - - - - by John C. McGregor

John Wiley, $5.00

THIS 400-page volume, illumined by 70 photographic illustrations and 168 drawn figures, maps, and diagrams, seeks to sum up and arrange in chronological order the vast fund of knowledge accumulated mainly by American students of southwestern archaeology during the past 100 years. It is high time this task was accomplished, and it is fortunate that it could be done by one who lives and works in the field. There have been earlier and more or less incomplete attempts, but on a field so large and so invitingly rich, constantly being worked, a general presentation is soon out of date. This will doubtless happen again. Meanwhile specialization along various lines is well under way and it becomes a question whether in another decade or two any one student could by himself execute what is here achieved.

The author, after an introductory outline of the subject, presents a brief history of general exploration and the main steps in the more and more serious investigation from 1540 to the present day. He next defines his aims and methods, considers the problem of classification, explains the all-important subject of tree ring dating, and briefly treats ceramics as a main key culture trait. With this as background, he proceeds to describe in some detail the long succession of partly contemporary culture stages from the still questionable Mohave and Abilene finds (dated 20,000 B.C.) and the more certain Cochise, Folsom-Yuma and allied complexes (dated 8000 B.C.) through the more distinctly characteristic Mogollon, Basket-maker, Hohokam and Pueblo developments down to historic times, giving as far as possible the time and space ranges for each. In this connection it is of interest to note that the absolute chronology, as determined by the tree ring method, has now been carried back to 11 A.D.

The book deserves a critical review such as is not possible here. Slightly disappointed with the first few pages, the reviewer found himself more and more impressed with the presentation as he read on. Altogether the text with Appendices, Bibliographies and Index makes a book which no Southwest student can afford to neglect.

N. C. NELSON.

FIELD BOOK OF SNAKES OF THE UNITED STATES AND CANADA

- - - - - - - by Karl P. Schmidt
and D. Dwight Davis

Putnam, $3.50

THIS volume of the widely used Putnam series of field manuals conforms to the standards of the volumes already published. Preliminary chapters summarize folklore, history of the study of snakes in the United States, poison apparatus and treatment of snake bite, habits and behavior, methods of collection, preservation, and study. The remaining three-quarters of the book are devoted to simplified keys, brief descriptions, statements of range, and ecological notes. References to papers dealing with individual genera are included in the text, and a list of references at the back of the book provides general references as well as lists of the more important papers available for each state.

The identification of all recognized species and subspecies within the United States is made simpler by inclusion of 103 line drawings, four color plates and 82 photographs. This compact volume will be extremely useful to teachers, naturalists, and herpetologists, despite a tendency toward oversimplification. Subfamilies and suborders have needlessly been elevated to families and orders, and otherwise good line drawings seem to have suffered from printing on inferior paper. A better binding and better paper are warranted both by virtue of excellence of the text and by the price.

C. M. BOGERT.

THE MORNING STAR RISES

An Account of Polynesian Astronomy

- - by Maud Worcester Makemson

Yale University Press, $5.00

IN this scholarly work, Doctor Makemson has contributed greatly to the subject of primitive astronomy. This book will find its real audience among those whose broader interest allows not only for exact modern astronomical statistics and theories, but also for the astrological and imaginative astro-mythological concepts out of which, or on top of which, modern astronomy has grown.

The Morning Star Rises is not a book for the average layman, but should be of the greatest interest to students of the history of navigation, to those interested in astronomical origins and cosmologies, and to students of Polynesia. Here, in this specialized history of the Polynesians, are shown many of the most practical uses of astronomy throughout the ages.

Divided into eight main sections, the book deals in much detail with early Polynesian navigation by the stars. While the main slant always remains astronomical, there is included much fascinating material concerning the rituals and the hardships surrounding these early voyagers across unknown seas. Much of the book also is devoted to the Polynesian conceptions of the origin of the universe, a mythology quite as interesting as that of the Greeks or the Egyptians.

Among all primitive peoples a knowledge of the seasons and a workable calendar have been of the greatest importance. Doctor Makemson devotes one chapter to a study of the Polynesian calendar, its eccentricities, and its improvements. The Polynesian astronomer, as was true of most primitive astronomers, was also an astrologer, a "wise man," watching the sky for omens, and foretelling the future by the positions and appearance of the heavenly bodies. Sun and moon, as well as other celestial bodies, were regarded as deities. Included is a list of 772 heavenly bodies with their Polynesian names and, in many cases, their modern equivalents. There is also a description of one of the most important institutions of the Polynesians, the Astronomical School, in which young men acquired their detailed knowledge of the stars.

Marian Lockwood.

MAN AND THE VERTEBRATES (Third Edition)

- - - - - - - - - by A. S. Romer

University of Chicago Press, $3.50

THE new revised edition of A. S. Romer's *Man and the Vertebrates* will be most welcome in the classroom and laboratory of all the biological sciences. The first edition, which appeared in 1933 as the first of the New Plan texts of the University of Chicago, was among the best on vertebrate evolution. This new edition now tops the list in the field. Approximately two-thirds of the original text has been retained, but it embodies many changes and is brought completely up to date. To this is added a 26-page chapter on the frog, which is especially written to aid the student who uses this animal in the laboratory. Much of the sections on the higher fishes and on birds have been rewritten, and most of the parts dealing with fossil man and modern races are new. So many, and very favorable, changes have been made in the illustrations that the book hardly resembles the first edition.

Professor Romer makes perfectly clear the purpose of each part of his book, but that there is an inequality in treatment of the different subjects seems a valid criticism. For example, in a work of this type to devote 26 pages to the frog and only one page to such an important group as the insectivores seems a bit incongruous. The rodents get two pages. It should also be mentioned that in this one-page treatment of those ancestors of all the higher mammals, the author follows the older view that the tupaioids are insectivores instead of Primates. In general, however, the chapters dealing with the direct story of man's evolution from the earliest known vertebrates are excellent. Those of us who teach a course on the evolution of Man, however, cannot help wishing for a greater elaboration.

In this book Romer has made a splendid contribution. All teachers of elementary biology, comparative anatomy, and vertebrate paleontology ought to read it and recommend it to their students.

Erich M. Schlaikjer.

DOCTOR WOOD,

Modern Wizard of the Laboratory

- - - - - - - by William Seabrook

Harcourt, Brace, $3.75

THIS is a biography of Robert Williams Wood, long-time Professor of Physical Optics in Johns Hopkins University. He was 70 in May, 1938, and would normally have been retired as head of the Physics Department in that institution, but instead of being retired as "Emeritus" he was appointed Research Professor of Physics in the same university, and he is still going as strong as ever.

As a boy he was greatly interested in making things,—gadgets, and especially explosions—, and he liked to play outrageous pranks. His inventiveness has increased, and his imagination and sense of fun have certainly not grown less as he has grown older. In short, he has not grown up, and, of course, there is no hope that he ever will.

The book contains the stories, stripped of legend, of so many of his pranks that it is fascinating reading for these alone,—how he determined the composition of boardinghouse hash with the spectroscope; how he scared some darkies nearly to death by spitting fire into a rain-water puddle (this trick was accomplished with a bit of metallic sodium); how he kept cats off the back fence by placing on it sensitively explosive tri-iodide of nitrogen; how he offered his biographer a *handful of fire,*—to mention just a few. He was not what we ordinarily call a practical joker, —his biographer calls him a poltergeist.

When we consider his little book, *How to Tell the Birds from the Flowers,* which is now in its nineteenth edition, and its sequel, *Animal Analogues,* we are reminded of Lewis Carroll (C. L. Dodgson, the mathematician) and his *Alice in Wonderland.* When President Theodore Roosevelt saw the book on birds and flowers, he asked to see more of Wood's writings. So Wood sent him his textbook of *Physical Optics!*

His scientific work was in various fields, with an emphasis on the physics of light. He is responsible for the "electric thaw" that unstops our plumbing; the use of atomic hydrogen in the nonoxidizing welding process; the beginning of the sodium vapor lamps; the first photographs by infrared light; a beacon-lamp using ultraviolet radiation, that enabled convoys to maintain formation at night while remaining invisible to the periscopes of submarines; hundreds of other similar feats. One must read the book to realize the originality and scope of his experiments. Of interest to students of science is a list, in the back of the volume, of 263 of Doctor Wood's scientific papers.

Clyde Fisher.

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Handy Gadgets for the Nature Photographer

By CHARLES H. COLES

Chief Photographer,
American Museum of Natural History

MOST camera bugs are by instinct gadget lovers. The amateur nature photographer is no exception, and he will rejoice to learn that there are many accessories designed not merely to delight his heart but to proffer real help in making good pictures of his favorite subjects. Auxiliary lenses, close-up devices, reflectors, self-timers, specimen holders—all find their place in his accessory kit.

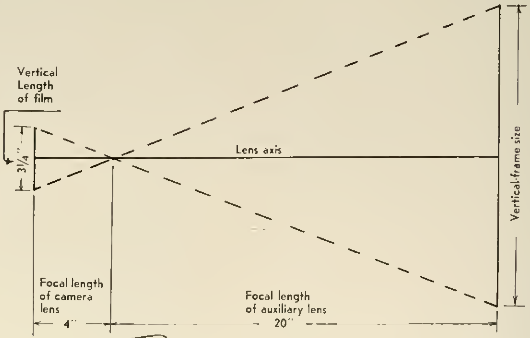
Close-up devices

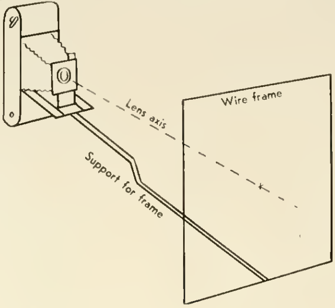
Perhaps in no other photographic field is there so great a need for special apparatus as in close-up nature work, where it is necessary to reveal the tiniest details of a subject. Most cameras do not permit focusing closer than six feet; yet to capture minute details it is necessary to approach much closer than this. Just as the eye of the inquisitive nature-lover makes use of the hand-lens or the microscope, so must the camera eye often be assisted with a similar device.

The closer the camera is moved to the subject, the farther the lens must be moved from the film. The ordinary camera will not permit sufficient extension of the lens for real close-up work, but if the lens is removable, it is possible to introduce an extension tube between it and the camera. Unfortunately, however, it is not convenient to use this device except with miniature cameras, and only with those miniature cameras that have detachable lenses.

The auxiliary lens

For larger cameras, the auxiliary lens will solve the problem. The auxiliary lens serves in much the manner as a magnifying glass and is attached in front of the regular lens. The general rule in using this type of lens is that its focal length must equal the distance between the object to be photographed and the camera. For instance, if placing the camera ten inches from the object will give an image of the desired size, then the auxiliary lens you use must have a focal length of approximately ten inches. These auxiliary lenses can be simple plano-convex lenses as long as the camera lens is stopped down well when the picture is taken.





One great advantage of using an auxiliary lens instead of extending the bellows is that the diaphragm markings on the camera lens itself are still valid and require no correction. Thus an exposure meter may be used directly, without special computation. When the extension tube is used, the exposure indicated by the meter must be increased to compensate for the added distance the light must travel after passing through a lens of a given

Continued on page 128

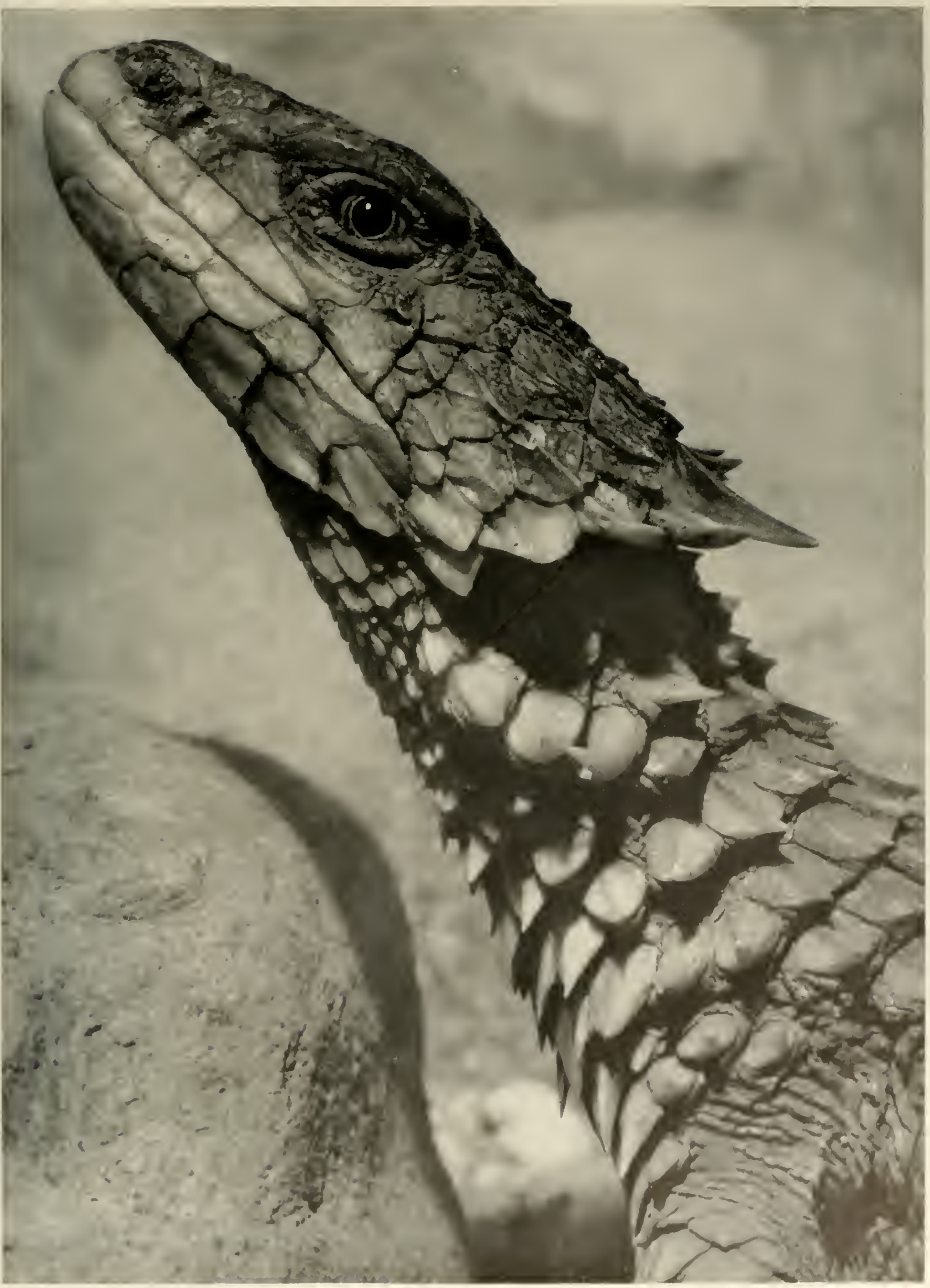


Photo by Charles H. C[illegible]

THIS MIGHT BE a picture of a dinosaur but actually it is a portrait of a live Zone-tailed Lizard whose head measures two and one-quarter inches in length

HANDY GADGETS FOR THE NATURE PHOTOGRAPHER—

Continued from page 126

aperture. When the image on the film is one-fourth the actual size of the object, add 50 per cent to the normal exposure; when the image is one-half actual size, double the exposure. At three-quarters actual size, triple the exposure; and when the image is the same size as the object to be photographed, multiply the exposure by four. For still higher magnifications, the increase in exposure is equal to the magnification plus 1, squared.

Methods of making close-ups

With all these close-up devices, it becomes more necessary than ever to be able to tell exactly what is in the field of the camera. There are three ways of ascertaining the exact focus as well as the exact field: (1) a ground glass focusing panel; (2) a range-and-view finder with correction for parallax; (3) a wire focus-finder.

The first method is by far the most versatile and useful and can be used on both miniature and larger cameras. Except in Graflex and reflex cameras, however, it is the slowest and for this reason cannot be used successfully with live and active animals. It also requires a tripod.

The second method, while extremely rapid in action, is restricted to the Contax and the Super-Ikonta *B*. With this device fastened to the top of the camera and an auxiliary lens over the taking lens, the photographer watches the subject through a small window in the range-finder as he moves the camera toward or away from the subject, until the two images on the window merge to form one. When this has been accomplished, the area shown in the view-finder is exactly that which the camera will take, and at the same time the camera is the correct distance from the subject for the auxiliary lens to make a sharp picture. Only three fixed distances may be used with this device. Two auxiliary lenses which may be used singly or in combination are supplied with this combined view and range finder, giving the three working distances.

The focus-finder

The third accessory for determining the exact field cannot be purchased but must be built by the owner of the camera. The wire-frame focus-finder consists of a rectangular frame made of heavy wire or small channel metal. This frame is connected rigidly to the camera by means of a bar which is screwed to the tripod socket of the camera. The object in using the frame is to show the exact area as well as the plane of sharp focus for your camera when it is fitted with a given auxiliary lens. This is the only practical method of equipping the simple bellows camera for close-up nature photography. The steps for obtaining the proper dimensions for the frame are as follows:

First, the focal length of the *auxiliary* lens must be known. If it is not known, determine it by focusing sharply the image of the sun on a sheet of paper, then measure the distance from the auxiliary lens to the paper. This distance will be the same as the distance between your frame and the lens. To determine the size of the frame, take a large sheet of wrapping paper and at one side draw a line which is equal in length to one side of your negative. If your camera takes a 2¼ x 3¼ inch picture, draw a line two and one-quarter inches long. Now draw a perpendicular to this line from its center and extend the perpendicular right across the sheet of paper. This represents the optical axis of your camera. The next step is to make a mark on this long line as far from the two and one-quarter inch line as the focal length of the camera lens; that is, if the camera has a lens four inches in focal length, make a mark four inches from the two and one-quarter inch line. Now measure from this mark the focal length of your auxiliary lens. Say it is 20 inches. At the 20-inch mark, draw a line at right angles to the lens axis. Now draw a diagonal line from one end of the two and one-quarter inch line through the focal point of the camera lens and extend it until it reaches the long line drawn through the 20-inch point. The distance between the optical axis and this last intersection will give you half the width of your frame. The height of the frame can be found in the same way, by lengthening your original line to represent not the width of the film but its length.

In use, the home-made focus-finder is attached to the camera by means of a bolt that fits the tripod bushing. The camera lens is set for infinity, and the auxiliary lens slipped into place over it. The whole camera is now moved toward the subject until the subject is surrounded by the frame. The close-up taken in this manner will be found to be sharp and clear. This method is excellent for flowers and similar subjects.

The importance of close-ups in natural history photography cannot be overestimated. Whether the picture be taken to satisfy the cameraman's curiosity or to illustrate a point in the teaching of natural history, the need is vital for sharp rendering of the most minute details. Equipped with whichever close-up device will best serve his purpose, the photographer stands ready to reveal the delicate veining of a leaf, the graceful outline of a flower, or the beauties and oddities of the smaller things of woods and fields.

LETTERS

Continued from page 67

Sirs:

I have been impressed by the potential value, for student use, of the charts you have been printing lately on the center double page of Natural History. . . .

A. N. Langford.

Bishop's University
Lennoxville, Quebec.

* * *

Sirs:

. . . I subscribe regularly to your magazine, which I value above all others, and of which I keep a permanent file. I find it invaluable as an aid and source in the teaching of General Science. The numerous charts which frequently are included in an issue are fine educational material and beautifully gotten up. Your handsome offer to send a corrected copy of the Dinosaur Chart free to all subscribers who request it merely confirms my pleasant impression of the really valuable, accurate and conscientious work which you are doing.

I hope that the war does not interfere with the work which the Museum is doing, because I consider it to be of the utmost importance that such work as yours be carried on without interruption.

Julian C. Smyth.

Poughkeepsie Day School
Poughkeepsie, N. Y.

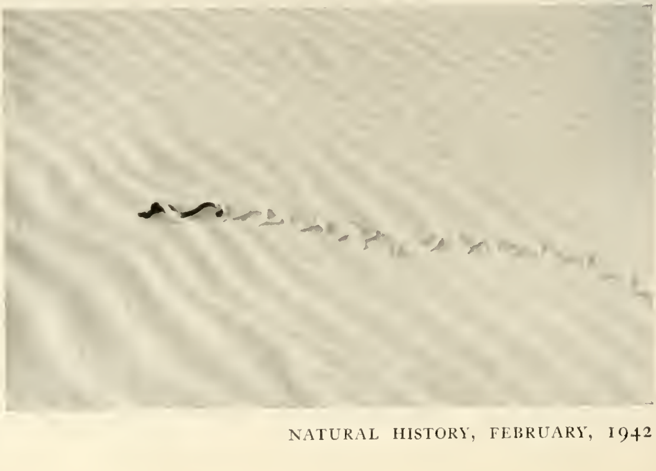
Sirs:

The accompanying photograph might be called "Journey's End." This "puff adder," or hog-nosed snake, had crawled at least a quarter of a mile over a sand dune in North Carolina and could go no farther. What his destination was we cannot know, as he was headed toward the very top of the dune. About two hours after the photograph was taken, he had managed to wriggle around and had started to back-track on his trail, which by that time had been obscured by blowing sand.

The study of his trail gives a good idea of how Mr. Snake moves along over a surface of sand.

Charles T. Berry,
Geological Department.

Johns Hopkins University
Baltimore, Md.



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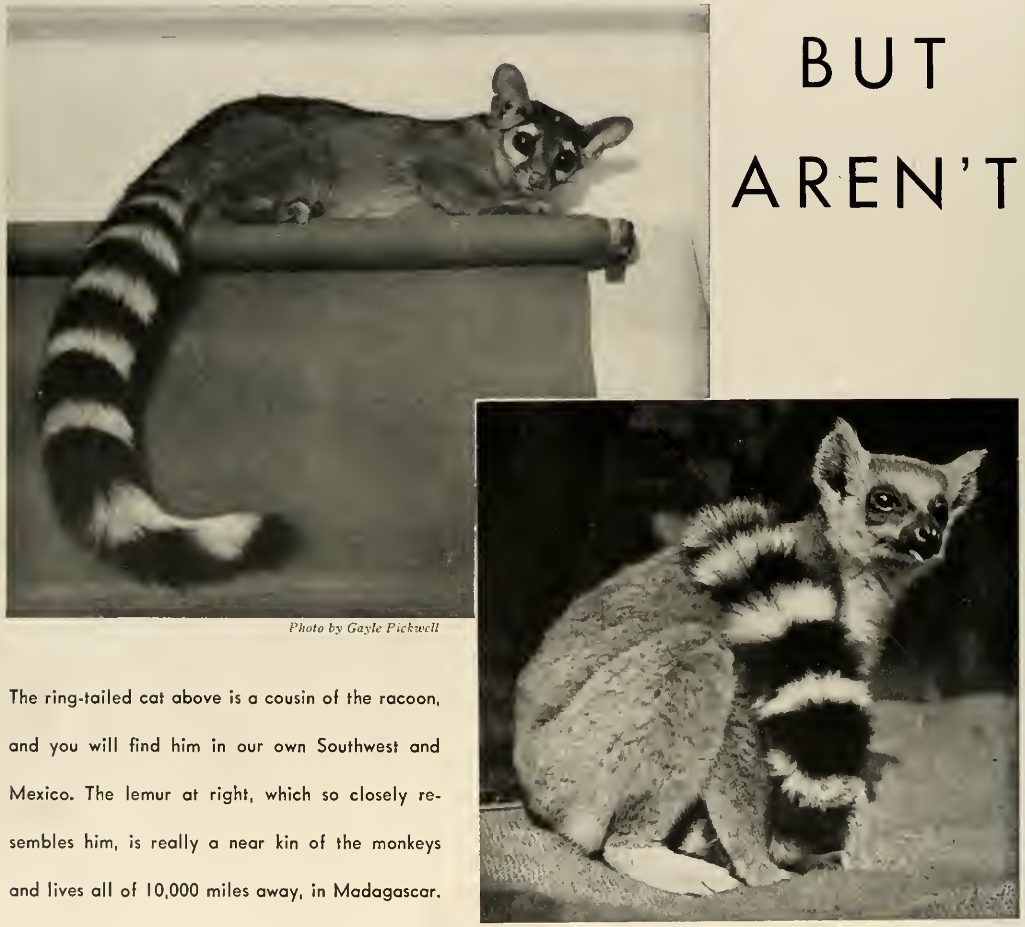

Photo by Gayle Pickwell

The ring-tailed cat above is a cousin of the racoon, and you will find him in our own Southwest and Mexico. The lemur at right, which so closely resembles him, is really a near kin of the monkeys and lives all of 10,000 miles away, in Madagascar.

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THE MUSEUM IN WAR

This war differs from earlier struggles in that even noncombatants seek no leave of absence. Its onset finds American civilians with their eyes open to the fact that total war spares no one. It follows that the Museum and its resources become part of the unswerving drive to victory.

What is the Museum? It is so many things that the question cannot be answered simply. Like all living institutions, it is first of all the men and women who make up its staff, its trustees, and others who put its goods to use. As regards individuals, its sinews of war have already been aligned through calls from the National Research Council for minutely classified personal information. Many members of our corps, in addition to those joining the armed forces, are being drafted for full or part-time duties "for the duration."

In another sense, the Museum is the aggregation of treasure and equipment that forms the medium in which the staff expresses its discoveries and conclusions. By means of special exhibits, by a fresh approach to those already on display, by instruction keyed to the necessities, the Museum can be of greater effectiveness in working toward victorious peace. The smoke of Pearl Harbor had not blown away before the Administration began to inquire as to what contributions to the prosecution of the war could be made by the staff, and what aspects of the Museum's regular function should be emphasized for the benefit of the public it serves. The prompt findings covered an astonishingly wide range of human knowledge and interest, so extensive that it would be impossible to cite one item of our educational and moral ammunition without slighting a hundred others. No time has been lost in an effort to make our store of cosmographic, biological, and anthropological information directly applicable to the singleness of purpose that fills all minds today.

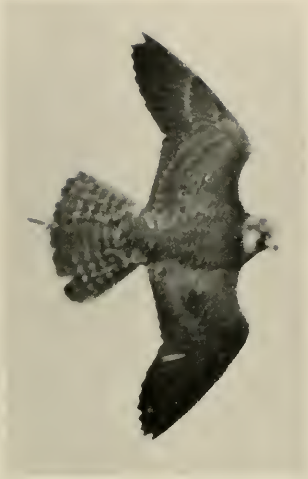
Quite aside from these timely opportunities, we cannot afford to forget that the routine work of the Museum, now as in normal days, is of the sort that stands high in any list of the world's intellectual, esthetic, and spiritual needs. Glance through a tabulation of the scientific departments, and linger over the significance of the research and exhibits that the mere terms encompass:

Anthropology: the science of man and his multifarious culture. Its learning has been distorted by tyrants to conjure up social philosophies as absurd as though the whole earth were still in the Dark Ages. Only a sound understanding of "race" and of the basis of human motives can keep mankind from slipping back again into the abyss. Mammals, Birds, Amphibians and Reptiles, Fishes, Insects, other Invertebrates. Thus tossed together, the strictly zoological departments suggest a flood of ideas, out of which we may snatch only a random few that are applicable to all life as well as to war: food, domestication, transportation, flight, streamlining, parasites, insect-born disease, insulation against heat and cold, competition and co-operation. Comparative anatomy, Animal behavior. The roots of man's curious and sometimes subhuman actions, as well as of his structure, begin far back in the kingdom of his fellow inhabitants of our planet. Nothing is better suited to make him humble, tolerant, and aspiring than to recognize the homologues of his own manners and customs, no less than of his bones and viscera, in his lesser brethren. Forestry and Conservation. "Conserving wildlife is promoting the best possible world for ourselves." Increasingly important in time of peace, the messages of this department become doubly so in war. We must never forget the tragic lessons of the last war in relation to the economy of Nature—when, for example, our "Dust Bowl" was born. Paleontology. We recall vividly a fighting man, named Clemenceau, who came direct from the pier in wartime to see our skeleton of *Tyrannosaurus*. Perhaps he cogitated upon the fact that, time and again, bulk and ferocity have passed away, to be succeeded by smaller mass and better brains. Is it too late to believe that the meek shall inherit the earth? Geology and related sciences. One of the avowed objects of the aggressors is mineral wealth. The President of the United States has pledged that, after our triumph, access to it will not be denied the vanquished. Astronomy. One's thoughts might begin, closely, with navigation, but they soon leap to realms where only the words of the Psalmist apply.

The conclusion is inescapable that the Museum helps to create winning morale, for the course of combat and the peace that must follow, by lifting millions of human beings out of the narrowness of their forebodings and prejudices into a view of the age, depth, and spaciousness of Nature, of which man is but a small part. Furthermore, since even total war leaves the majority of our population to carry on with the ordinary occupations of life, and to make the most of added difficulties, our task in war as in peace remains to keep the ever-probing, ever-changing tools of our science under the fixed light of a principle of the Museum's founders. This, as often repeated by the late President Henry Fairfield Osborn, is that the Museum must, above all else, stand fast as a temple of Truth.

Robert Cushman Murphy

The American Museum of Natural History



An unusual photograph of a Peregrine falcon in soaring flight, taken by George G. Goodwin. The bird has banked sharply, exposing its back. Note the falcon's straps, or jesses, extended from the feet, and the head of the hawk turned to watch the falconer's lure

LETTERS

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. . . I enjoy NATURAL HISTORY more than any magazine I subscribe to. . . .

MRS. D. L. GAILLARD.

Greenville, Tex.

* * *

SIRS:

. . . Your magazine is always a source of pleasure to all who pick it up, not only to look at but more so to read.

L. D. W. MAGIE.

Peterborough, Ontario.

* * *

SIRS:

Your photographic column seems to me more helpful than anything I find in publications devoted to photography. . . .

CHANT OWEN.

New Haven, Conn.

* * *

SIRS:

I was especially interested in your December article on dinosaurs . . . I can't begin to tell you how much I look forward here in the Army to receiving NATURAL HISTORY each month. It helps me keep up with the latest scientific theories and discoveries. Thank you very much.

PVT. LLOYD MASON SMITH.

Camp Joseph T. Robinson
Little Rock, Ark.

SIRS:

. . . I am especially interested in the evolutionary and biological significance of your recent fine articles on these subjects and your clever original charts.

A. H. CLEVELAND, M. D.

St. Louis, Mo.

* * *

SIRS:

. . . While I find your magazine superior in every respect, I feel that you are especially to be commended for the excellent layout of NATURAL HISTORY.

THURLO B. THOMAS,
Science Department.

Phillips Exeter Academy
Exeter, N. H.

* * *

SIRS:

. . . I have enjoyed my previous issues of NATURAL HISTORY Magazine very much. I have found them most helpful in my school work. I have also found them a source of great enjoyment in my home.

LELAND NICHOLS.

Hawthorne, Calif.

* * *

SIRS:

In accordance with your offer I would like to have a copy of the Dinosaur Chart with correct labels.

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Lands of New World Neighbors. (New Horizons: C.B.S. School of the Air.) The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

•

FRIDAYS over the Columbia Broadcasting System Network from 4:15 to 4:30 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.

topic in connection with our biology course in Central High School. This chart as well as several others should be of great help to clear up obscure points in a general way. I would like to have them larger to hang on the wall and be visible to the entire class at once . . . R. D. HISSONG.

Sioux City, Iowa

It has unfortunately not yet been possible to print enlarged copies of the charts referred to.—ED.

* * *

SIRS:

Can you supply reprints of the valuable article on the Bataks of Sumatra, "The Spirits of Batak Land" . . . I could use eight reprints for students in a course in Malay Ethnography . . .

ROBERT M. ZINGG,
Department of Anthropology.
University of Denver
Denver, Colo.

NATURAL HISTORY Magazine regrets that no separates of this article were printed and that copies of the issue containing it would have to be purchased, at 50¢ each.—ED.

* * *

SIRS:

. . . I wish to express my high opinion of the increasing progress of the Institution and of the Magazine, the contents of which are always most interesting . . .

DR. ALBERTO E. J. FESQUET.
Buenos Aires, Argentina

* * *

SIRS:

. . . The enjoyment I receive from NATURAL HISTORY grows each year. It seems to me the issues of each month surpass the ones before in beauty and timeliness . . . EDNA F. DENNISTON.

Rockville Center, L. I., N. Y.

Continued on page 183

Gulls in winter plumage form a beautiful pattern of wings in this remarkable photograph by Charles F. A. Gallagher

NOTICE Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

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VOLUME XLIX—No. 3 ★ ★ ★ ★ ★ ★ **MARCH, 1942**

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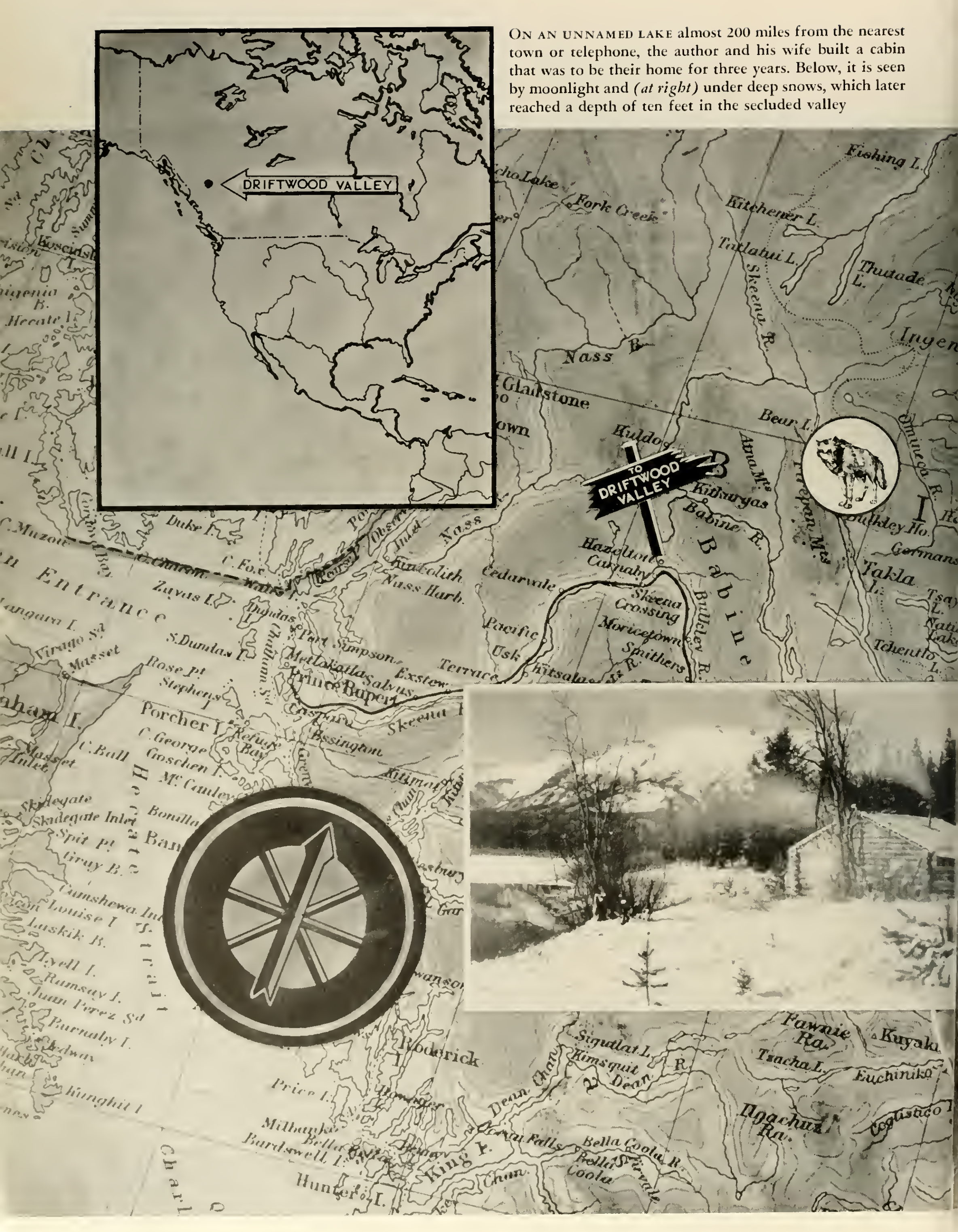
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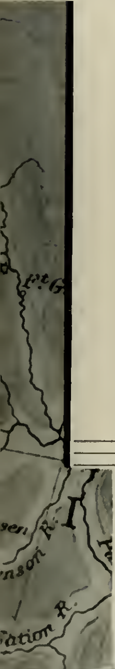
On an unnamed lake almost 200 miles from the nearest town or telephone, the author and his wife built a cabin that was to be their home for three years. Below, it is seen by moonlight and *(at right)* under deep snows, which later reached a depth of ten feet in the secluded valley



Three years in the WOLVES' WILDERNESS

A man and his wife make their home far from civilization in British Columbia's vast solitude to study wildlife amid mountain scenery of surpassing grandeur

By John F. Stanwell-Fletcher

Photos by author except where otherwise designated

Photo by T. C. Stanwell-Fletcher

On a rainy August morning in 1937 my wife and I set off into the mountains from Hazelton, British Columbia. We were in search of a spot somewhere in the 800 square miles of the wild, uninhabited Driftwood Valley where we could build a cabin home and live a peaceful, simple life, in natural surroundings; where we might find an existence which would lead to a greater mental and physical health than that which was lived by most of our friends in towns and cities. We were not on a big game hunting or scientific expedition. We wanted to study the wildlife in natural conditions throughout all the seasons, especially during the long months of a northern winter. Our collections and observations were to be made on behalf of the British Columbia Provincial Museum at Victoria.* For the greater part of three years we studied the wildlife and we worked to live, a none too simple business in a northern wilderness.

After traveling almost 200 miles from Hazelton we found for our home a lovely little lake surrounded by great mountains and spruce forests. It was an isolated spot, 200 miles from the nearest auto road, electric light, and telephone. The nearest settlement, composed of a Hudson's Bay Company trading post, a few white families and prospectors, and some Indians, was 75 miles to the south, at Takla Landing. A few Indian families lived 30 miles to the north, at Bear Lake. We were cut off from all communication with the outside world for months at a time. We had no radio for the first two years, and we were entirely alone. Our contacts with humans came chiefly during the winter when we infrequently saw the few Indians whose trap lines were in the Driftwood Valley region.

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* "Naturalists in the Wilds of British Columbia," *Scientific Monthly*, January-February, March, 1940. Lists of all plants and animals collected in the Driftwood River Valley are being completed for publication.

We hiked and climbed over mountains and valleys, easy going and hard going. Our snowshoe trails radiated from the cabin over many miles of territory, and by the end of the first winter dozens of tall trees had sheltered the beds of spruce and balsam boughs where we had slept, sometimes in temperatures of 50 degrees below zero and with eight to ten feet of snow. Often we reached places where no white man had ever been before. This immense forested mountainous land, which we had for so long wanted to see, was very beautiful at all seasons and especially in winter. It was kind to us sometimes, and sometimes it was harsh and inhospitable and bitter, but we loved our life there and were very content.

Our cabin is situated at the northern end of a small spring-fed lake which drains into the Driftwood River by a short channel. The surrounding country supports mixed forests of spruce, balsam, pine, and poplar. Numerous lakes, beaver ponds, sphagnum bogs, and mountain streams thread the entire district. The Driftwood River, with its gravel bars and log jams and marvelous Dolly Varden and rainbow trout, winds its erratic way through the center of the valley, between the Driftwood Mountains on the west and the Omineca Mountains on the east. To the north of the valley lies Bear Lake, while Takla Lake, 50 miles away, bounds the southern end. Most of the country west of the Driftwood River is cut by high mountain ranges and long ice fields. It has not yet been explored or surveyed, and only a small portion of the valley is known to the white man. In winter the valley is particularly isolated, and the wildlife probably approximates a natural state.

The most common mammals were moose, wolves, black and grizzly bears, beaver, otter, marten, fisher, mink, varying hares, weasels, red and flying squirrels, chipmunks, and a variety of mice and shrews. On the mountain ranges, mountain goat, marmots, porcupine, and some caribou were to be found. With the exception of some of the smaller mammals these animals were inaccessible and very difficult to observe. The bird life of this region was fairly abundant; we noted a total of 134 species.

Of all the wild animals around us we were perhaps most interested in the timber wolves, those beautiful and most highly intelligent animals of the northern wilderness. The writer was fortunate enough to observe wolves at distances of fifteen to 75 feet on at least 20 occasions during 1941; and it is from these personal observations, together with reports from local Indians and notes made during fourteen years spent in those parts of Canada where wolves are found, that opinions have been formed.

As the snow deepened in December, we noted more wolf tracks than the occasional single or double track that had previously been seen. Two wolves ordinarily originated a trail, then other wolves would follow it, each stepping in the other's tracks. The trails usually led through the forests to a moose-yard or its vicinity, where the moose fed on tall grasses below thick spruce trees. But there was little snow under these trees, and the moose was seldom attacked, for its hoofs are sharp and deadly when it has firm footing.

By the first of January, Indian trappers began to report small and large packs of wolves. All of these were seen traveling along the edges of lakes. They were in groups of from four to 31, moving slowly and in single file. By the end of January, with six to eight feet of snow, the wolves began to hunt moose in earnest. Deeper snow beneath erstwhile sheltering trees forced the moose to travel farther for food, and in deep snow they were easy prey for the wolves. Within an area of five square miles just north of us, seven moose were killed by wolves during the winter of 1938-39. Although all of these were not eaten at once, the wolves returned and cleaned up the carcasses later.

At this time of year, the weather obliges the wolf to subsist chiefly on moose flesh, fresh or ancient. In the deep snow the lightweight snowshoe rabbit can easily avoid the heavier wolf; and grouse and ptarmigan cannot easily be stalked by an animal that sinks to the belly or lower with each step. Only the moose, whose great weight forces him to travel with bent forelegs used as snowshoes, can be hunted successfully. That the wolf's food is not easily obtained even then, is evident when one follows a trail in the snow. We have the skull and skin of a large black dog wolf which was found alive with broken ribs and leg bones, underneath a tree. Surrounded by moose tracks, blood patches and moose hair, the wolf had been crippled in a great battle. Similar cases were frequently reported by Indians and apparently usually occurred when the wolf had attacked the moose alone.

The power and endurance of wolves is astonishing. We have two large dogs, one of which weighs a little over 100 pounds. He is remarkably powerful—capable of carrying a 50-pound pack for eight hours and then romping playfully after the pack is removed at camp. Without the aid of a snowshoe trail these two dogs were physically incapable of traveling more than five miles in one day through the six-foot soft snow of the forest. They sank almost out of sight and were forced to make progress by great leaps which quickly exhausted them. Even when following a trail made by two pairs of snowshoes, the two dogs, hardy as they were, soon tired. And yet the wolves, many of them weighing 130 pounds and over, with no broken trail to follow, travel incredible distances.

In one instance, during the first week of February, 1941, I followed two wolves, presumably mates, for 27 miles. The larger tracks were partly obscured by the smaller ones over the first fourteen miles. Then the larger wolf moved to one side, with no perceptible change in pace, and dropped behind the smaller one. The snow was approximately six feet deep and very soft. The track made by these wolves resembled a shallow trench one foot deep and sixteen inches wide, with foot and leg tracks going deeper. The leading wolf simply pushed its way through the snow. After the change in leadership there was one pause—not a rest—where both wolves sprinkled a dead stump. Then they continued on their way. Two days later I followed these same tracks eight miles in the opposite direction, and there was no change in leadership—no sign of rest being taken, just the same deep furrow in the snow, made by a powerful chest. The dog wolf had apparently led for a total distance of 22 miles, breaking the trail without rest. I lost the trail when heavy snow came.

Toward the end of February, after being noticeably silent, the wolves began to give voice. Often on still days or nights the Driftwood Valley echoed with their love song, which is the most beautiful of wild music—markedly different from the hunting cry, which is a prolonged series of high notes, persistent and savage. The movement of packs could be followed by the echo of their voices as they went along the valley. Longer days and ever-increasing sunshine, with cold nights, brought a crust on the snow, and snowshoe rabbits became once more a part of the wolf diet.

It is in February and March that one can find evidence that the big wolves apparently appreciate the beauties of their surroundings. I am aware that this statement may be considered fanciful. But after fourteen years in parts of Canada where wolves are found, and with many opportunities of observing them and their signs, I believe that the timber wolf, in common with many other wild animals, enjoys lovely surroundings.

Within a few minutes' snowshoeing from our cabin in the Driftwood Valley, a hill rising abruptly above a small lake gave a magnificent view of six separate mountain ranges, snow-covered peaks, glaciers, mixed forests, and frozen lakes. In late winter we visited this enchanting hilltop, particularly when the moon's brightness lit up the snow-covered valley and mountains clearly. At the top of "Wolf Hill," as we called it, we invariably found wolf tracks. On the western rim, where there were many open vantage points, we would find the impression of a wolf that must have sat for a long time, facing the best of views. The imprint of the hind quarters was hard and ice-encrusted, such as is left by a dog that has slept in snow all night. Little or no food was to be gotten on this hilltop, for deep snow covered the few mouse holes. Varying hare and squirrel tracks were rarely noted there. Dense forest hid any sign of moving game in the valley below. The wolf tracks always led directly from one vantage point to another. Spots favored by the wolves were precisely the ones where we delighted to linger ourselves because of the view. We were always careful to avoid unnecessary trampling of the snow and left the wolves a clear way to each spot.

Once at midnight on Wolf Hill, while we silently drank in the beauty of a cold February night, with a brilliant moon lighting the entire valley for miles, a wolf immediately below us sent out a call to his mate; a low, musical note, deep and vibrant, more like a movement than a sound. Then he gave a rising, ringing call which faded gradually and ended in two distinct and incredibly low notes. Twice the call went out, and from far away there came an answer, faint but clear. Three more calls and answers rang out before the two wolves apparently came together. Then silence, and we were left with the view.

From our first arrival in the country we made every effort to preserve a sanctuary around the cabin and the lake by which it was built. After two years we were rewarded by an increasing number of observations on birds and mammals. The wolves, perhaps the most cautious and wise of all creatures, began to use our snowshoe trails.

On numerous occasions one or both of us were followed by as many as six wolves, particularly when we traveled at night. Once, as we were returning by moonlight from a long day's trip, I went ahead to start the cabin fire, leaving my wife to travel more slowly a mile or so behind. She was an expert on snowshoes, was always armed, and often traveled alone in this country. With that peculiar sixth sense one acquires alone in the wilderness, she felt she was being followed, though she could hear and see noth-

Many snowshoe journeys were made, and many tall trees sheltered the balsam beds where the naturalists slept

A view through the cabin door in early winter, a season in which the wolf chorus was silent and tracks scarce

Photos by T. C. Stanwell-Fletcher

ing. This fact was confirmed the next day by two Indians traveling an hour or so behind us. They had seen the tracks of six wolves closely following the snowshoe trail of my wife. At other times we frequently found fresh wolf tracks made over our snowshoe prints of the day before. We often noted spots where wolves had apparently watched from behind undergrowth as we went by, and their voices were sometimes heard within 100 yards of the cabin. In summer the loud cowbells on our two pack horses seemed not to disturb the wolves, nor did the barking of our big dogs at play.

The wolf and man

Toward the end of our stay I became convinced, by actually watching wolves, who in turn watched me, that they were unafraid and quite familiar with my habits. Possibly they realized that because they were never hunted or trapped by us there was nothing to fear. At the same time, I felt no fear of the wolves—only a tremendous respect and admiration.

There are many stories of European wolves hunting and attacking man, but we have not been able to discover any authentic case of a person being attacked by the timber wolf of North America. It is my belief that there are no authentic cases. Indian hunters, from the Hudson Bay to Alaska confirm this belief. A wolf in a trap will fight and bite, naturally. Wolves do not hunt man; they hunt for food, and man flesh is apparently distasteful to them. The bodies of men who have died in the wilderness remain undisturbed, except by birds and flies, until they rot and are moulded into the ground. Cleaned skeletons are the result of maggots, not wolves. The timber wolf apparently prefers the meat which he kills himself; occasionally he touches kills made by man, but he shows remarkable intelligence in avoiding man-made traps, no matter how cleverly disguised.

In the Driftwood Valley district the wolves are apparently most vociferous in March and August. In late February and March, the love song, so clearly different from the hunting song, is such that once heard it is never forgotten. A pair of wolves begin the chorus, usually in the late evening. Others near and far take up the song in low and high pitch without a discord, and the whole valley resounds with melody. There is something vital and soul-stirring in it, which makes the listener feel that these wolves have a great soul as well as love of life. It is a wild song—everything about the wolf is wild, in the true sense of the word. Wolves, perhaps more than any other creatures, seemed to us to be the spirit of the wilderness itself. Everything that we learned of them pointed to the fact that they are strong, fearless, peace-loving, faithful to each other. With their great intelligence they seem determined to live on in spite of man's attempt to destroy them, in spite of his

The cabin late in February, when on still days and nights Driftwood Valley began to echo with the most beautiful of wild music—the wolf's love song. When the trees were bare, the chorus rang clearly. Heavy snow muffled the voices and made the moving pack sound far away

Mrs. Stanwell-Fletcher and the two huge dogs who shared with them the trials of the trail and the comforts of the cabin

(Right) The country around Driftwood Valley is cut by high mountain ranges and long icefields. A scene across Blue Lake

Photo by T. C. Stanwell-Fletcher

(Below) Hundreds of square miles of unexplored and unsurveyed land were within reach of the lonely cabin. The nearest Hudson's Bay post was 75 miles to the south. "Sometimes this immense forested mountainous land was kind to us," writes Mr. Stanwell-Fletcher. "Sometimes it was harsh; but we loved our life there and were very content."

Photos by T. C. Stanwell-Fletcher

unreasonable and selfish desire to dominate the universe and subdue all other living creatures.

When the young are born, usually about the first week of April, the wolves are heard only rarely. Occasionally there was the cry of what we believed to be a solitary wolf, whose lonely call was a throbbing succession of low notes, rising slightly in pitch as they faded away. Once or twice a single voice was heard in the valley, which might have come from a dog whose mate was with her offspring. On these occasions there were the usual low notes, but instead of loneliness, a joy and awareness of life sounded so clearly that it made the listener smile in sympathy. In late May and early June, when the young were growing rapidly, the wolves were heard more frequently. In the early morning, soft yaps and yelps from young wolves could be easily distinguished, while the older ones gave short cries and lazy howls as though they were just waking.

In the summer months food is more easily obtained and one wolf no longer needs to join forces with others in hunting. Then we saw individual wolves, in many types of country, from valley streams and river beds to snow-covered mountain peaks. On the mountaintops wolves hunt young goats wherever they can separate them from their elders. One night I remained on a mountaintop in bitter cold at 8500 feet altitude. Early in the morning I was rewarded by the sight of seventeen goats who, fleeing from two wolves, ran and leapt where there appeared to be no possible foothold. Eventually they climbed to safety on a jagged, precipitous face of rock.

The summer fish feast

Early in August the clear water of the Driftwood River is turned to red-gold by spawning Kokanee salmon, a small, red, subspecies of the sockeye. For ten days or longer, countless numbers of this fish fight their way up the river, to spawn and then die, fouling the water with their decaying bodies as they are washed downstream. Thousands of dead fish are left on the banks and gravel bars, and for a few days a great stench pervades the country, calling all wildlife to the river. Birds, bears, wolves and lesser animals then enjoy a fish banquet. Soon the gravel bars and river shores are clean once more and the stench is gone. For a few more days the wolves move slowly along the banks, fishing for the last of the kokanee. Wading and swimming across still pools, fording shallow rapids, they eat and sleep and sometimes gather together for a song. I was present at one of these song-fests, an unforgettable experience and a privilege which is perhaps seldom granted to man.

For three years we had hoped and tried in vain to get pictures of wolves, particularly in 1941. We had visited and revisited many moose kills, and we had traveled considerable distances during winter and spring to regions where the Indians thought wolves most numerous. We had various harrowing adventures as we blazed our trails over that tough unexplored country. On one trip when loose rocks gave way beneath him, our fine old pack horse "Baldy" fell hundreds of feet down a mountainside. Overbalanced by his pack, he rolled and crashed down the mountain, out of sight. He stopped, feet in air, against a huge dead log, less than ten feet from a sheer drop onto solid rock. A minor scratch and a badly bent frying pan were the only results other than the fright we received!

AT A MOUNTAIN meadow camp, drying meat for future use

THE INQUISITIVE YOUNG WOLF with whom the author played "hide-and-seek." The American timber wolf does not attack man

A COYOTE PUP, kept for four days and then released

THE AUTHOR with a Dolly Varden trout fresh from Driftwood River. In August, spawning kokanee turned the water to red-gold, and the animals enjoyed a fish banquet

Photos by T. C. Stanwell-Fletcher

Toward midsummer we had almost given up hope of ever getting sufficiently close to photograph even one wolf. Sometimes as we lay in our sleeping bags under the trees, we heard wolves calling. As we climbed the mountains or forded streams we saw wolf tracks. From camps on high alpine meadows, where wolf food was abundant, we hiked and climbed over many, many miles, in hot blazing sun or ice-cold snow and hailstorms. When we returned to our cabin we had given up all hope of pictures. The thing seemed to be an impossible job, but we would make just one more trip.

We were almost ready to depart when we were startled by a sudden outburst from wolves by the river, a quarter of a mile from our cabin. Thick undergrowth, willows, and dry ground made a silent approach to the spot impossible, even though I wore moccasins. As I neared the river all became abruptly silent. For an hour I remained as still as possible, but saw and heard nothing until I returned to the cabin. Then the singing began again from the same place as before.

Still hoping to get pictures, I hurried across the lake in our small, homemade skiff, and, coming to the river, poled my way up as quietly as possible against the rapid current. When I reached the spot from which the singing had come there was nothing but silence. Dozens of wolf tracks had just been made along the shore and sand bars.

After an hour or more of waiting under a bank overhung with willows a black bear and cub came from the bushes on the opposite shore, 40 feet away.

DRIFTWOOD VALLEY. Here wildlife, unlike protected animals in National Parks, was in a more natural state and much harder to observe. The naturalists studied it through all seasons, especially winter

Two Mountain Caribou, a species very much larger than the woodland caribou and reaching a weight of 500 or 600 pounds.

Well protected by its quills, the porcupine lives untroubled by any serious enemies in the Driftwood River region, as elsewhere over most of forested Canada

It was necessary to work to live, and a mountain caribou was welcome food

Photo by Indian Michelle

After winter's heavy snows, al

Wolves were heard within 100 yards of camp and never seemed to be disturbed by the loud cowbells carried by the two pack horses

(Right) The author at 8300 feet in the Omineca Mountains east of the Valley: a vantage point from which mountain goats were observed during the summer

Photo by Indian Sapolio

owers sprang up along the streams

Photo by T. C. Stanwell-Fletcher

Meat for the morrow adds cheer against the flaming sky in a lonely land

For a few minutes they caught kokanees in the shallow water, taking them up in their mouths. While I was watching them in the late afternoon light, I suddenly saw a large gray-black male wolf standing in the middle of the river. Wolf and bears looked at each other for some moments and then turned away to hunt for fish. The wolf eventually saw my skiff, 30 feet away and, after a moment of statue-like stillness, he loped slowly and gracefully off, across the river into the willows, where he apparently stopped. The bears moved quickly away, and the next hour or so passed quietly.

As daylight faded, I saw willow branches moving in three places, as though shaken by a moving body. No sound was heard, and I seemed to have all of that still and darkening country to myself. Then, without any stirring or preamble, wolves began to sing in the willows opposite. The river at that point was shallow and quiet. There were probably ten or twelve wolves, judging from the noise and different voices. They did not move about, just sat still and sang. Each outburst was started by the same wolf, whose voice was the lowest and most dirge-like of any I had ever heard. The volume of sound, its wildness, and the nearness of it all held me spellbound. Seldom is the wilderness so kind to man as to allow him to be present at such a moment.

Grizzly and cub

Inadvertently I had parked my skiff directly below an opening in the willows which marked the end of a game trail. Suddenly there was a crash, and I turned to find a grizzly bear with its cub. They had not seen the boat and were starting to climb down just above me. My .348 game rifle flashed flame a foot over their heads. A few more steps and the bears would not have been able to turn round. However, the blinding flash from the gun frightened them properly, and they departed in a hurry. I swallowed and tried to regain composure, feeling greatly annoyed at what I supposed was surely a termination of the singing. But almost at once it began again, from the same place across the river. The wolves were determined to sing; even the loud report of a rifle, so near by, could not deter them.

At this time, my wife was doing home chores around the cabin a mile away; cooking supper, watering the horses, and tying them up for the night. She heard the rifle shot and thought that undoubtedly I had been obliged to shoot a grizzly bear in self-defense, for there was almost no other reason why I would shoot at that hour of the night. Then she heard the wolves howling again. It was phenomenal for them not to have been silenced by the rifle shot, and although she was usually fearless and had a remarkable sympathy with the wilderness creatures, she was badly frightened. The one dirge-like note of the wolf I have already mentioned, different from all wolf notes with which she was familiar, sounded so like a human voice in pain that she was about to start off into the dark to find me. Luckily I was on my way home by that time, and she heard me paddling up the lake. The wolves were still singing at intervals.

I found that ten or more wolves were in the habit of traveling along the river slowly, up one side and down the other. At one large gravel bar they appeared to spend some time in catching Kokanee salmon; so I went there every morning before three o'clock for the next three weeks.

Cold work

Facing the gravel bar was a pool or backwater from the river, which afforded an excellent hiding place. Sometimes I simply sat in the skiff; sometimes I stood in the water in my waders. It seemed to be entirely a matter of keeping absolutely still and waiting indefinitely. Every day, from three in the morning until noon or later, sometimes in the late afternoon and evening, I waited and watched. During that time I saw sixteen wolves, all within fifteen to 75 feet of my skiff. It was the coldest job I have ever known, and the most exciting.

The first wolf I saw was a gray fellow, standing in the water with a flapping kokanee in his mouth. The skiff was moving at the moment, and the wolf saw it at once. For a second he stood still, then lowered his head eight inches, while the hairs on his shoulders rose stiffly. A moment later he loped away. On the fourth morning, after I had sat quietly and shivered in the raw air for two hours, a large yellowish wolf appeared. It moved to the water's edge without the slightest sound, gliding along with the wolf's stiff-legged yet lithe, almost cat-like gait. It pounced on a kokanee, then at the sound of the movie camera stopped dead still. Again the head lowered and the ruff stood stiff. The camera stopped, and what was to become a frequent game began: the single movement of a cramped finger would send the wolf away.

Three more wolves were seen, but in such bad light that pictures could not be taken. They all appeared silently, and were well out into the open before I was aware of their presence. They vanished as soundlessly, stepping over the small stones of the gravel bar as though they walked on broken glass.

As possible bait for wolves I had brought from the mountains the fatty lining of some mountain goat stomachs. No part of the bait had been handled except with clean gloves. As I drifted by in the boat one day I dropped three pieces of it on the gravel bar. The first wolf to appear stood stiff-legged, head low and moving slowly from side to side, inspecting the bar. It was 4:15 in the morning. A minute later the wolf backed carefully away to the willows and vanished. Some time afterwards a low howl came from the willows behind the boat, and I had the feeling that I was being watched. Crows took the bait when the sun came up.

A lonely female

At six o'clock the following morning, with the temperature twelve degrees below freezing and a cold, clammy mist lying over the river, a large coal-black bitch wolf appeared. She was thin and very hungry. Her belly was drawn in, and I had the impression that she was old, without young. Moving leisurely up the gravel bar, she stopped once or twice to catch struggling salmon in the shallows. Then she came to a piece of bait, seeing it without apparently getting the scent first. Without any hesitation she ate the bait. Then she went to the river and caught three more kokanees in rapid succession. A few minutes later she vanished, but she returned in fifteen minutes or so, examined the place where the bait had been, and once more entered the river. At that moment a number of wolves, probably a family gathering, began a song near by. The voices of young puppies were plainly distinguishable, their high quavery notes straining to compete with the louder, more mellow ones of the elders. On hearing this the black wolf waded across the rapid current to within 20 feet of the skiff. Then she leapt up the bank, three feet high at that point, and sat down in the tall grass, showing only a vague outline of her body. She began to sing.

In a low, vibrating dirge she seemed to bewail her loneliness. Not loud, but soft and mournful came the lament, and it was easy to imagine that this wolf had lost her mate and was alone in the world, with only memories of a happy past and of litters of frisky young pups at her side. For perhaps an hour she sat there, then she returned to the water and, approaching the boat to within fifteen feet, buried her head to the shoulders to catch a fish.

It was a moment later that she saw me or heard the camera, and for a long time we watched each other. Her beautiful golden eyes widened. The only other touches of color in the coal black body were her white and gray whiskers and muzzle. Long minutes passed, then she turned slowly, forded the river, stood where the bait had been, and once more looked at me.

With teeth chattering, and belly shivering from the cold, I tried to expose as much film as possible, rewinding the camera with stiff fingers at the moments when the wolf was turned away or had her head in the water. It was with the greatest effort that I could hold the camera even reasonably still. Most of the resulting pictures are shaky.

By August 20th there were few kokanees left in the river. The dead fish had all been picked up, and only one or two struggled in the shallow waters. Almost a week passed with no sight of wolves, although we heard some. Bears crashed around in search of berries; an otter was seen once, and two coyotes. A large number of muskrats appeared every morning.

Hide-and-seek

Then I saw more wolves. The third one was a young male, well fed and strong. His belly bulged uncomfortably, and he moved slowly, though with an air of abandon. Approaching to within 30 feet of the camera, he saw the boat and stopped, leapt back a dozen yards, and then sat down to watch. After a few minutes he came on again, head lowered, ears pricked forward. Once more he sat down and for a few minutes peered this way and that, with head low, then high, staring at the boat with great interest. Then I said "Hello!" The young wolf bounded into the air. For a while he played hide-and-seek with me, in and out of the willows, once interrupting the game for a good long scratch. Then he vanished into the bushes and began to circle the boat. Three times his head showed out of the willows at different places. Later, I thought I saw the same pup twice. On the last occasion I was almost chagrined at his complete disregard of my presence. The young fellow fished and amused himself happily until a call, which must have been from home, came from far away, and off he ran into the forest.

I believe that most of the wolves seen at close quarters were aware of my presence. Since no wolf was shot or harmed in any way by us or others in this area, it seemed probable that they realized there was no danger. Had one of them been harmed, the others would doubtless never have allowed themselves to be seen and watched. I do not believe that wolves are afraid of man; there is nothing even remotely cowardly about their actions. The wolf is a truly wild creature and a very valuable factor in controlling overpopulation of one district by any other race of animal. It is my opinion that bounties on wolves are now, in mose districts, unnecessary and unjust. If the wolf is exterminated we shall have lost one of the most virile, wise, and beautiful of all wild creatures.

STRATEGIC METALS

NUMBER III

CHROMIUM

Now doubly strategic are chromium's corrosion resisting properties

By FREDERICK H. POUGH

Associate Curator (in charge), Geology and Mineralogy,
The American Museum of Natural History

CHROMIUM, like tin, comes from a single ore mineral—chromite, an oxide of iron and chromium. Its most familiar use, like that of tungsten, is of relatively little importance in wartime. Just as the filaments of light bulbs use an inconsiderable percentage of the tungsten produced, so does chromium plating use a small quantity of chromium.

Contrary to what might be supposed, plating with chromium is achieved by a chemical rather than a metallurgical process. In common electroplating, a metal is transferred from one object to another by means of an electric current. The positive terminal, or anode, is an actual bar of silver or other metal as the case may be, which becomes smaller as the metal is transferred through the solution to the object to be plated, the cathode. Chromium however, will not dissolve in this way. Therefore, a soluble chromium compound must be added beforehand to the solution, and the solution must be renewed as the process continues. This procedure is made necessary by the resistance to chemical attack that makes chromium useful for auto trimmings, bathroom fixtures, and cocktail shakers.

An unusual piece of ore from Alaska: the chromite balls are rarely so pronounced. Decorative chromium plating represents one of the best known but least important uses

AMNH photo by Bierwert

The layers are so thin (two-millionths to five ten-thousandths of an inch thick) that the total quantity of chromium utilized in this way is practically insignificant.

There are some other chemical uses, interesting and in a way important, but not essential. Our army might look very different were it not for chromium, for chromium is used in the dyes of olive drab. Our soldiers' boots and belts were tanned with the aid of chromium salts. But these are not the uses that place chromium second on the list of strategic metals. The Army and the Navy owe much more to chromium than is covered by the chemical uses.

Chromium plating resists tarnish and corrosion, and this is what makes chromium of value in alloys of steel. Stainless steels contain high percentages of chromium. In addition to its resistance to corrosion, chromium imparts other remarkable properties to steels, depending upon which other metals are added. Nickel and cobalt are commonly used; molybdenum, tungsten, copper, vanadium, zirconium, or silicon may also be introduced. Low chromium steels for armor plate and armor-piercing projectiles, and for gasoline engines, may use from one-half to five per cent of chromium, super stainless steels twelve to 30 per cent. Such steels are for use in chemical plants at high temperatures, where great resistance to corrosion is required. In such alloys nickel may be as abundant as chromium, though usually not. Chromium cast irons and chromium tool steels have also been developed, and in all of them the strength and corrosion resistance are the important properties.

Because chromium has high resistance to electric currents and resists oxidation, it is also valuable for electrical heating equipment. Wires for such purposes contain eight to 20 per cent chromium and 54 to 80 per cent nickel, with the balance iron.

Chromite is closely related to the common ore of iron, magnetite. Like that mineral, it occurs in eight-sided crystals, but unlike magnetite it is not magnetic unless the iron content is very high. The chromium content of the ore varies greatly from place to place, even in the richest deposits.

Chromite is a common associate of peridotite or basic rocks (rocks low in silica) and the serpentines so often related to them. Only in such regions, indeed, have chromite deposits been found. Mineralogists believe that the chromite separated from these rocks of low silica content when they were in a molten state, and that it was then perhaps injected as more or less pure masses along with the peridotite. This manner of formation explains the typical deposits of chromite, which are series of lenses of irregular masses, often along the contacts of the intrusion.

When pure, chromite contains 68 per cent chromium oxide, but like most minerals, it rarely occurs in that state. Some of the atoms of chromium may be replaced by iron or aluminum, and some of the iron by magnesium and calcium, through a process common in nature known as isomorphism. The result is that the actual chromium content may be as low as 45 per cent or even less. No one can judge by inspection what the chromium content of ore may be; only by analysis can its value be determined.

Chromium ores too low grade for chemical and metallurgical purposes are still highly valued for a totally different use. In lining metal-treating furnaces, chromite bricks are the only substance that can be used where an inert material is required that will not react to either acid or basic matter. Chromium's high melting point also makes it ideal here. As prices permit, this use is steadily expanding. Forty per cent of the chromite consumed in America goes into furnace linings.

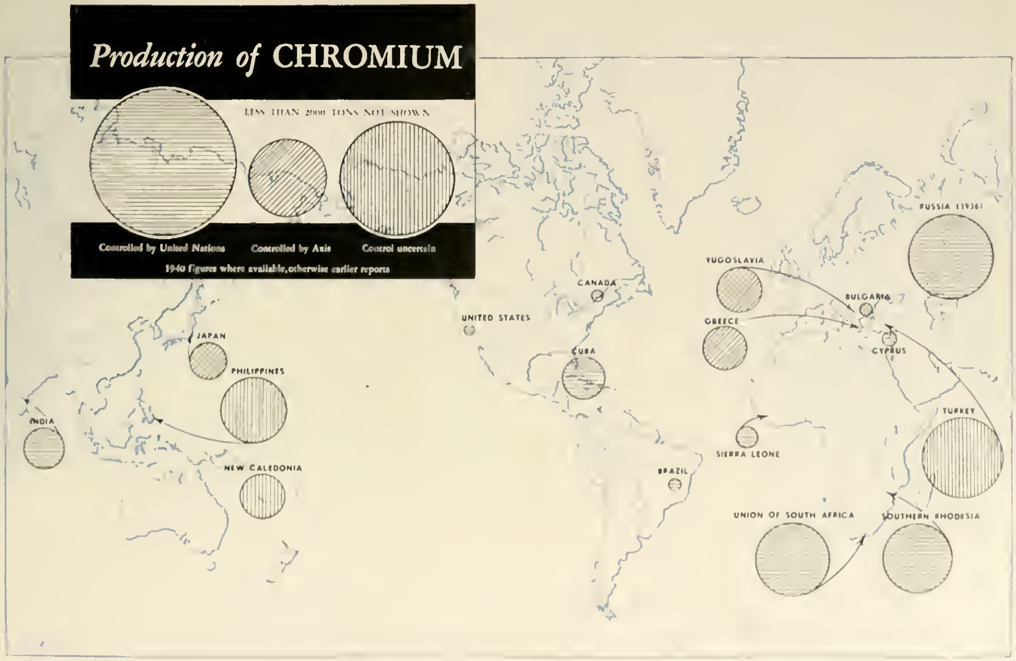
The United States was once, for a brief time, the principal producer of chromite. For a country now having to import so much this seems strange; but in 1827, when mining for chromite was begun in Maryland for a green and yellow paint pigment, we were the only producers. However, Turkish production began in 1860, and the work at that mine finally stopped in 1897. Turkey then led the world for many years but it, too, fell behind as new deposits in New Caledonia and Rhodesia were developed.

The statistics on chromite production are most confusing. Nation after nation developed new chromite resources, which were interrupted and upset by changing conditions of world politics and finance. In 1940 the United States imported over half of the total, and we now probably consume far more than that. Our production, on the other hand, has been less than a fourth of one per cent of the total. Clearly we shall need to import vast quantities to keep our mills going through 1942.

Specialized war uses make chromium doubly strategic. The port of the Garand rifle is made of stainless steel, gears of trench mortars, superstructures of destroyers, armor plate on submarines and battleships,—all require these special steels. Interesting new developments include a method of rolling thin sheets of stainless steel for airplanes, to take the place of aluminum and to be three times as strong. Another process deposits a thin layer of stainless steel on ordinary sheets for lightweight armor plate.

The United States has few areas yielding chromium, and these are small. Certainly we have nothing to compare with the Great Dyke—a sheet-like, more or less vertical intrusion four miles wide and 330 miles long—which is responsible for the important production in Southern Rhodesia. About one-fourth of our imports came

Continued on page 155



NATURE'S PLAYHOUSE

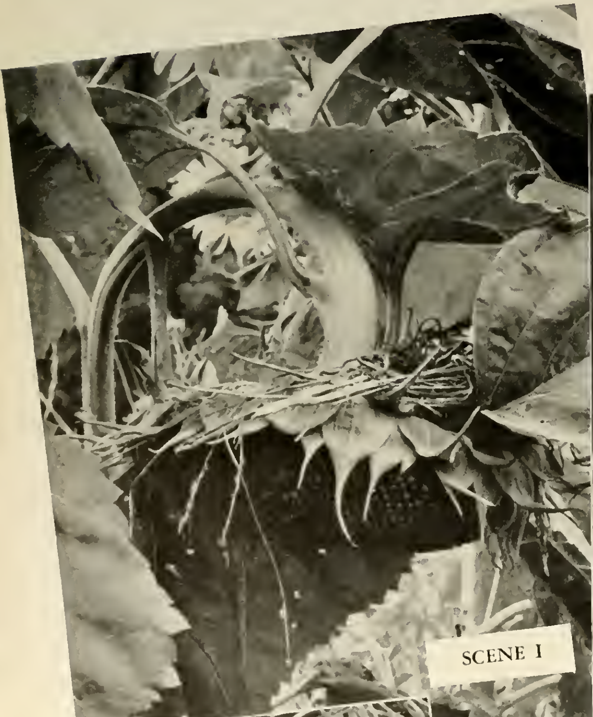
Presents

The Sunflower and the Song Sparrow

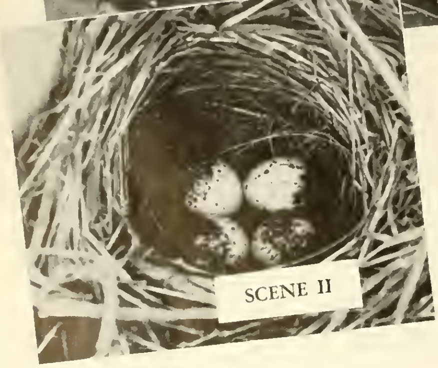
A Nature Drama in Five Scenes

By GEORGE A. SMITH

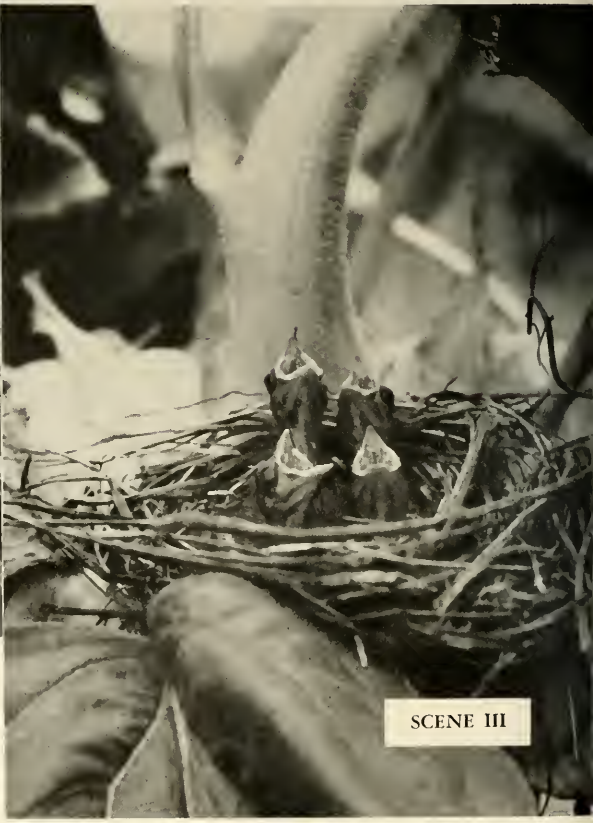
ALL PHOTOS BY THE AUTHOR



SCENE I



SCENE II



SCENE III

SCENE I The song sparrow built her nest on the turned-over head of a sunflower stalk. Broad leaves protected the nest from sun and showers

SCENE II The nest was lined with long strands of animal hair. In it the song sparrow laid four eggs, covered with numerous rufous-brown spots

TIME: In the month of July

•

PLACE: In the turned-over head of a golden brown sunflower,
growing at the edge of a vegetable garden in Pennsylvania

•

CHARACTERS: A friendly little song sparrow
(Melospiza melodia), and her family of four

•

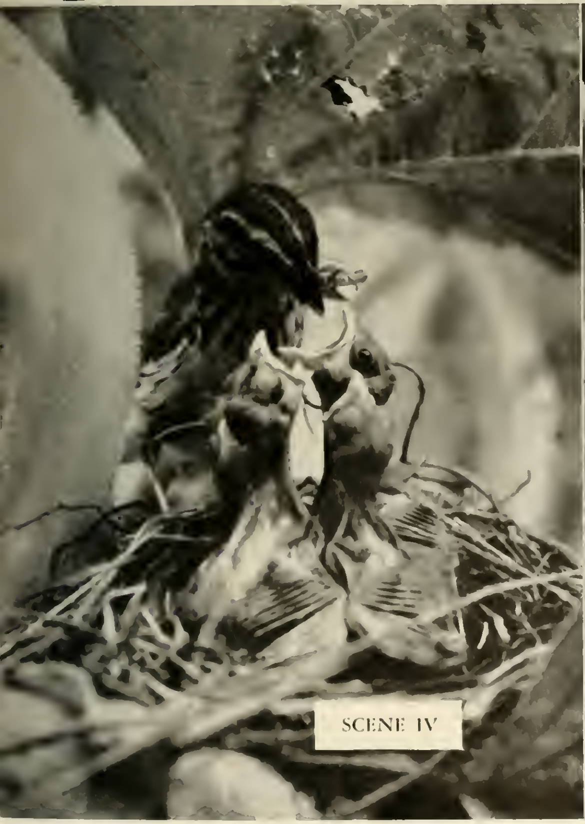
PHOTOGRAPHY: Kine Exakta, with
Zeiss Tessar f:2.8 lens and extension tube

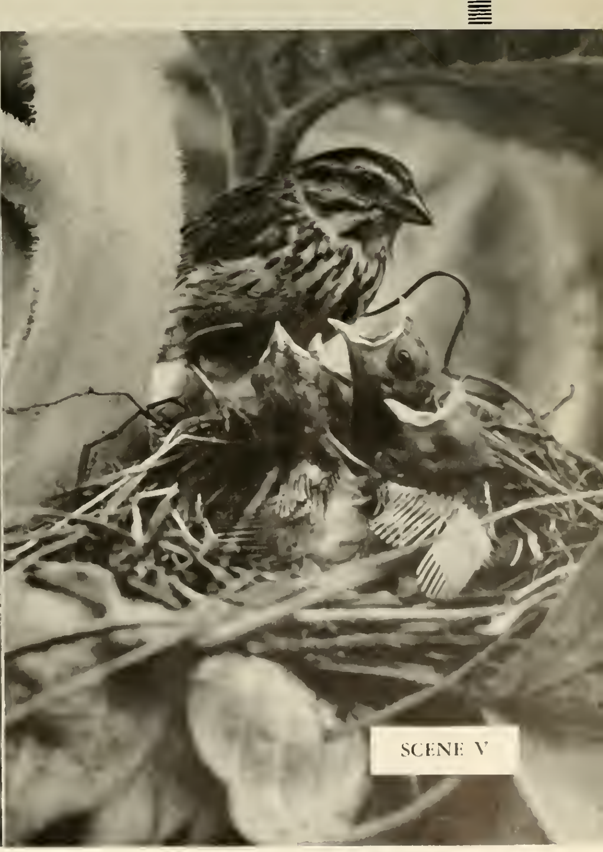
•

LIGHTING EFFECTS: An overcast afternoon sky

•

PROPS: A blind arranged in the shape of a tent within a few feet of the nest

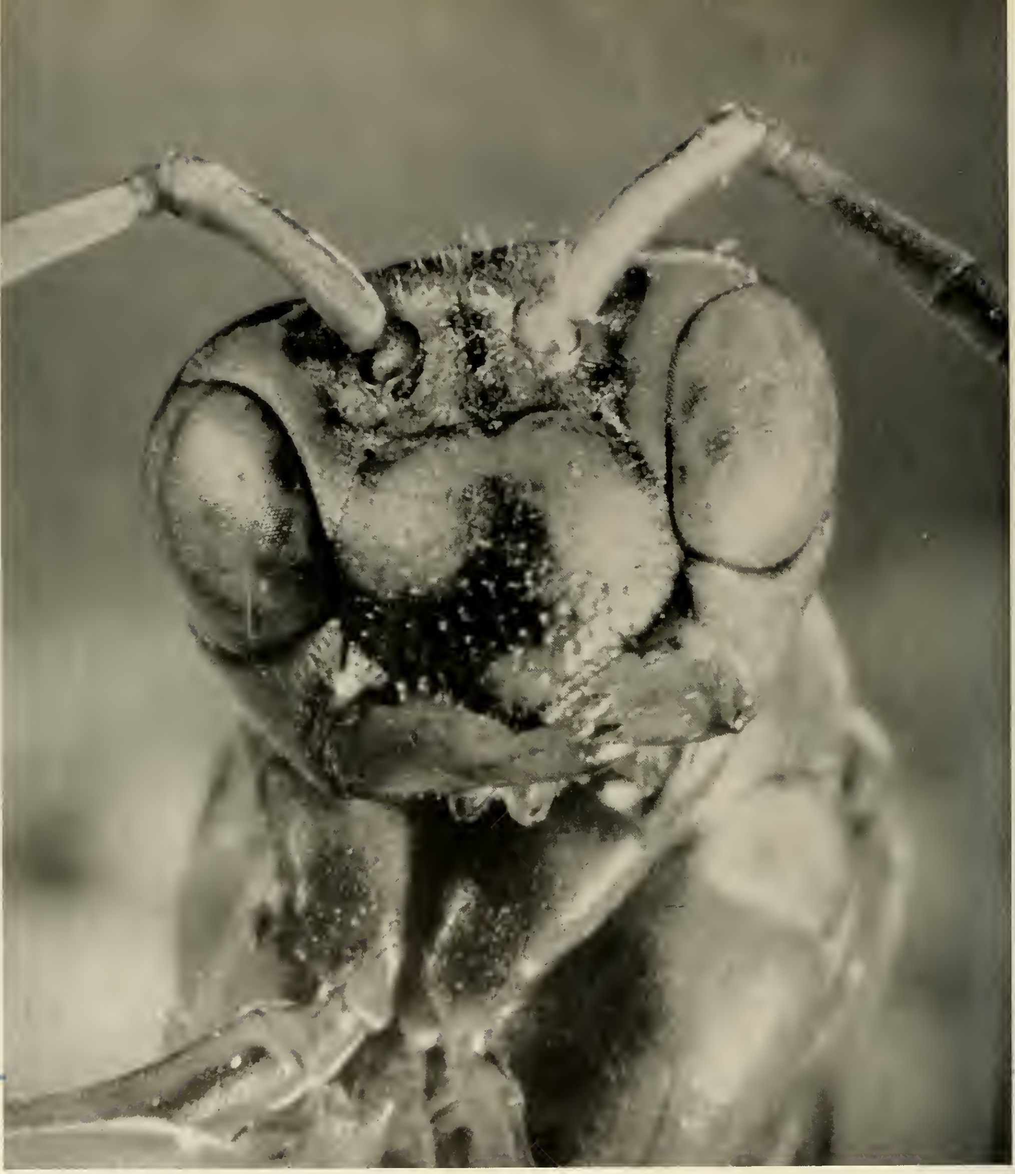




SCENE III Eventually four little heads appeared, with mouths wide open. Legs and wings were too feeble to support the tiny bodies, but the necks lifted wide-open mouths high above the nest in readiness for food

SCENE IV All four grew well on grass seeds and juicy cabbage worms, until a big grasshopper was only a mouthful. Hair-like down gave way to stubby feathers. Both parents were kept busy

SCENE V After each mouthful, the mother bird paused a few seconds. The squeaky little voices grew louder, promising that next season's meadows would ring again with the characteristic notes of the song sparrow

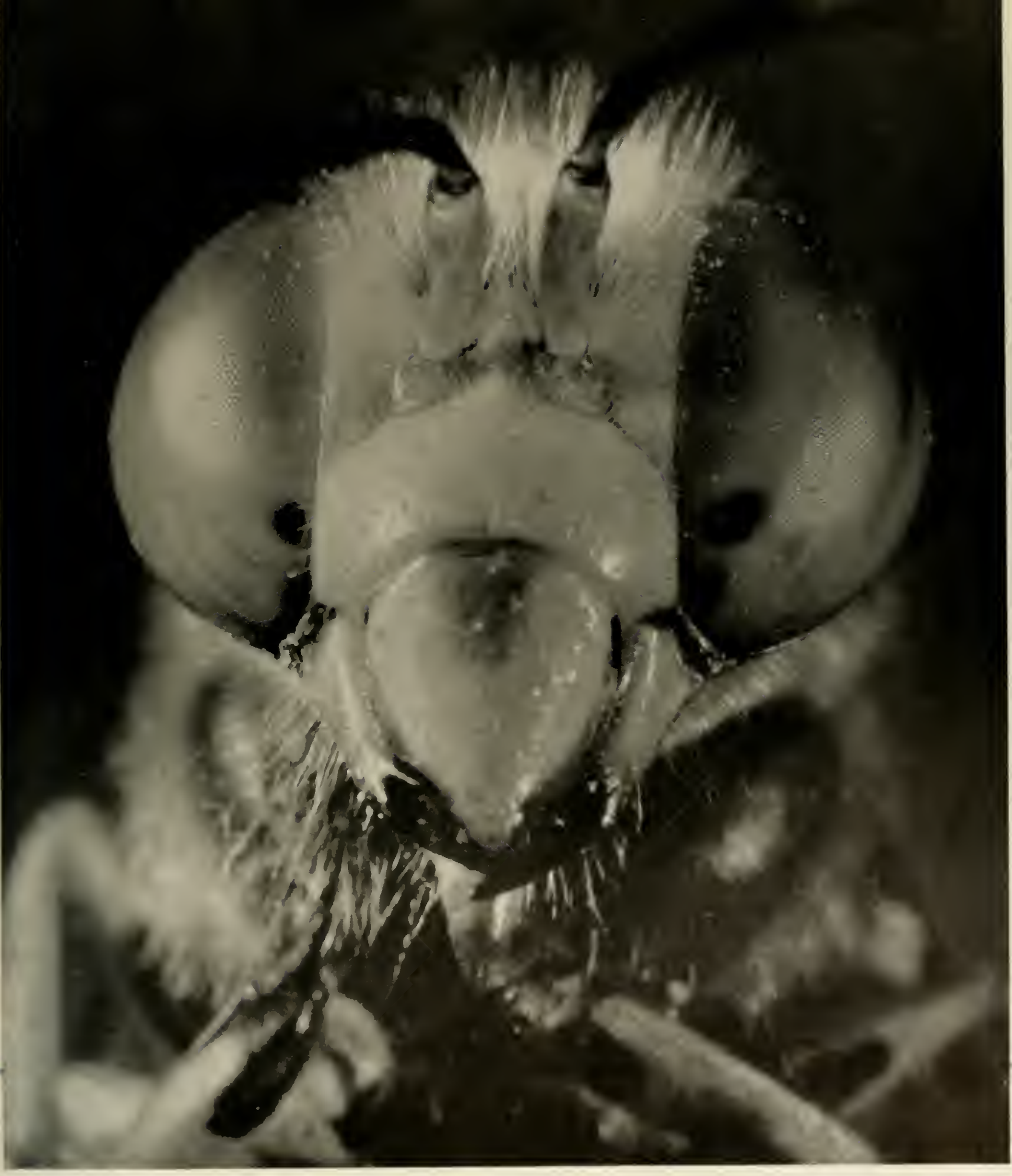


USING JAWS hinged at the sides of its head, the common paper-making wasp, *Polistes pallipes,* gouges out bits of wood to chew into pulp for nest making. It produced wood-pulp paper millions of years before man. In eighteenth century Europe, an experimental book was once printed on wasp-produced paper

ON THE FACE OF IT

By EDWIN WAY TEALE

ALL PHOTOS BY THE AUTHOR

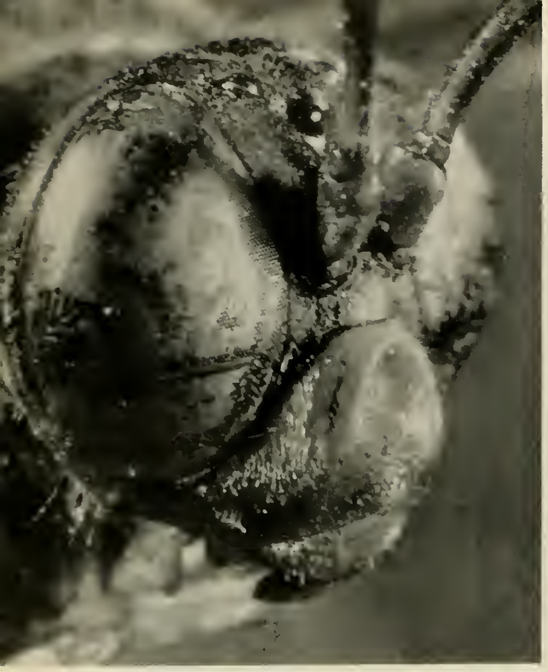


THE GREEN-BANDED digger wasp, *Bembex spinolae,* can be observed to burrow into the ground to lay its egg on a paralyzed fly deposited at the bottom of the tunnel. When the wasp larva emerges, it begins to feed on the fly. As this baby wasp grows, the mother brings additional flies to feed it

IN an advertisement for a book which recently appeared in NATURAL HISTORY Magazine, the question was asked: "What Wasp is that?" My interest was aroused immediately. This simple question opens up a fascinating field for exploration. Wasps are familiar to every back yard. Yet few of us have seen the faces of these common insects. Enlarged to easily observed proportions, they present a surprising variety of countenances. All you need for an Alice-in-Wonderland expedition into the wasp world is a net for capturing the insects, a microscope or magnifying glass, and a handbook to introduce you to the insects.

As a taste of what you will see, I show you here the portraits of five common wasps. No two of these insect faces look as much alike as the faces of a Chinaman and an Indian. All mankind can be divided into five races—yellow, red, white, black, and brown. But the five wasps you see here are only a small sample of approximately 12,000 wasps found in the world. And these wasps, in turn, constitute only a fraction of the order of insects known as Hymenoptera, while the Hymenoptera form but one of about 30 orders of insects comprising a total of more than half a million different species.

Seen through the magnifying glass, the coloring



and form of a wasp's face, the interesting differences in jaws and feelers, the formation of the great, many-lensed eyes—all provide an intriguing peep into another world. I have never seen a first-visitor to this world peer through the magic doorway of the microscope without an exclamation of admiration and astonishment.

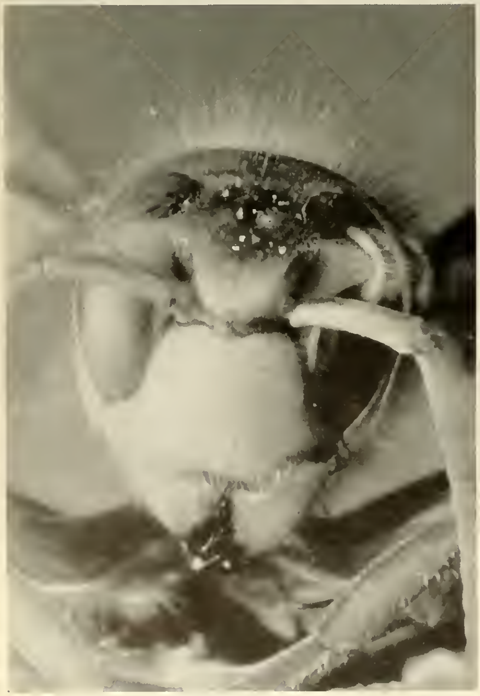
An added charm to exploring the wasp world is the curious activities of the creatures we meet. Each has its own individual habits. In the world of men, one Chinaman may be a Buddhist, another a Christian; one Indian may be a hunter, another may spend his life raising grain. But each wasp hews to the line of its individual customs. The strangeness of some of these customs is indicated in the captions under the portraits of these five wasps.

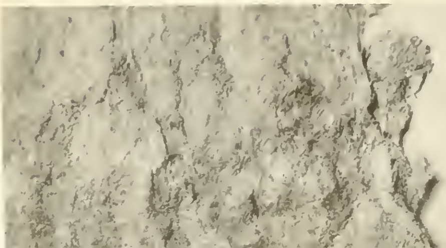
So the question "What Wasp is that?" opens the door to a near-at-home world which holds infinite marvels for anyone who explores it.

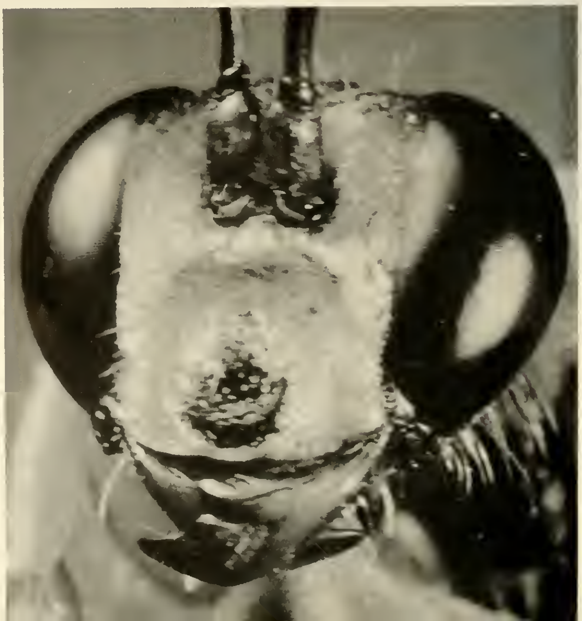
(*Left, above*) THIS WASP, which looks somewhat like an insect bulldog, is the cicada-killer, *Specius speciosus.* It stocks its burrow with paralyzed cicadas. Because its prey is heavy to carry on the wing, it often drags its burden up trees and then launches out on a slanting descent that gains ground toward the burrow

(*Left*) ABOUT A CENTURY AGO, *Vespa crabro,* the hornet, arrived from Europe. It catches insects as big as monarch butterflies, snipping off wings and chewing up the bodies to provide "hamburgers" for the larvae in its covered-in, wood-pulp nest. Adult wasps live on nectar almost exclusively; their larvae get meat. Below is a photograph of paper from a white-faced hornet's nest

(*Below*) LONG-HORNED GRASSHOPPERS fill the underground larder of this digger wasp, *Chlorion ichneumoneum.* It flies home holding its prey headfirst, like a streamlined pontoon. The powerful forked jaws of this wasp aid it in gouging out dirt while digging its burrow





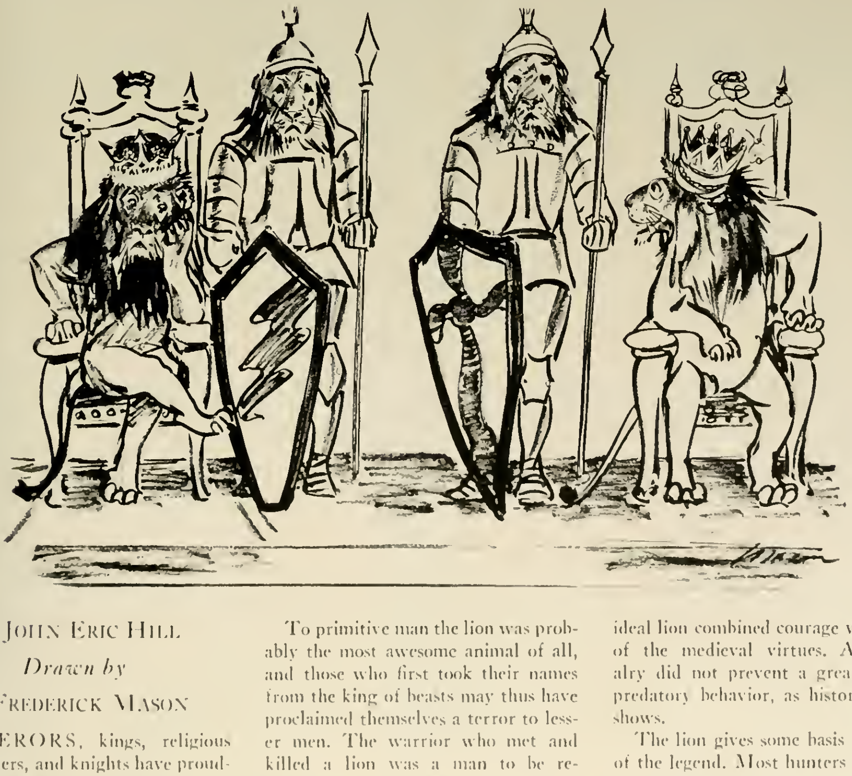


CHROMIUM *Continued from page 149*

from the Philippines in 1940 and 1941; slightly more was imported from Rhodesia, and nearly as much from South Africa. Nine other nations contributed the rest in 1940, with Turkey producing an important amount of high-grade ore. Chromium is certainly essential to our war effort, and the loss of the Philippine supply and that of New Caledonia, would be serious. However, African imports can probably be increased to compensate, as long as the South Atlantic routes are kept open.

Meanwhile, the American Government is rapidly increasing domestic output by an arduously pushed investigation of the nation's chromite resources. California produced some tons of chromite in the last war, and those deposits have been reopened and further explored. Other deposits in Alaska, Oregon, Washington, and Montana have been prospected, and some production has already been achieved. Some stock pile has been built up, though that work was started much too late. Probably still untouched South American deposits can, in time, be made to yield considerable quantities of higher grade chromite than is produced today. If supplies become short, economies can be effected to a certain extent in the utilization of chromium steels where the peculiar properties of strength and resistance to corrosion are not so essential.

THE LION, KING OF BEASTS



By John Eric Hill

Drawn by

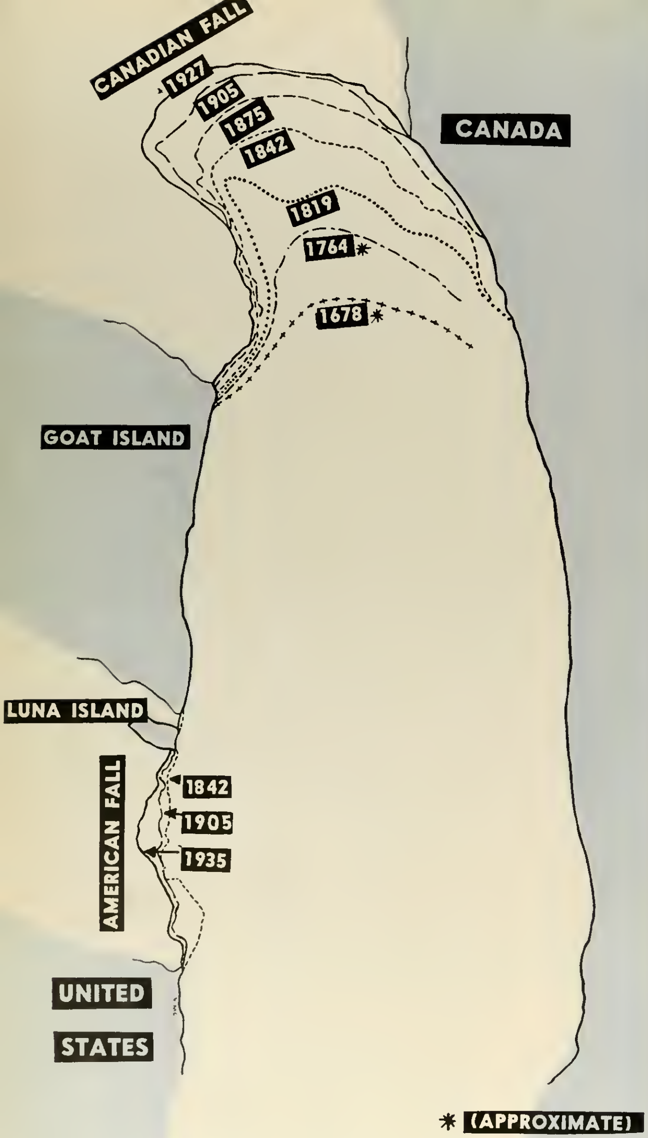
G. Frederick Mason

EMPERORS, kings, religious leaders, and knights have proudly borne names referring to the lion: Richard Coeur de Lion; Henry the Lion, Duke of Saxony and Bavaria; Haile Selassie of Ethiopia, the Lion of Judah; Leo, the name of thirteen popes; Leonidas (that is, lion-like), the Spartan leader at Thermopylae; Leonard (strong as a lion), and other variations have been used. The lion is the wild mammal most often mentioned in the Bible, and it is probably also the most mentioned in other literature.

To primitive man the lion was probably the most awesome animal of all, and those who first took their names from the king of beasts may thus have proclaimed themselves a terror to lesser men. The warrior who met and killed a lion was a man to be respected, perhaps the spirit of the lion was now in him.

During the Middle Ages chivalry developed. The old predaceous ways of the European peoples were mixed with and somewhat mollified by Christian influences. There were no longer lions in Europe, but the Crusaders brought back accounts from the Near East, and the traditions of the classical age were embellished with these stories. The lion was considered a most suitable emblem for a knight, for the ideal lion combined courage with most of the medieval virtues. And chivalry did not prevent a great deal of predatory behavior, as history clearly shows.

The lion gives some basis for much of the legend. Most hunters testify to the courage of the king of beasts, even against such odds as the modern rifle. More hunters have been killed by lions than by any other African game animal, but in many cases wisdom is the better part of valor and the experienced lion may seek to avoid his archenemy, man. A lion does not kill for "sport." He is often "sportsmanlike" in preying on the more powerful animals, while a duiker—a small antelope—may share the thicket in which he lays up.



Almost a symbol of eternity to many visitors, America's most famous waterfall has actually shifted its position nearly a quarter of a mile in 264 years and is sure to change its appearance in years to come

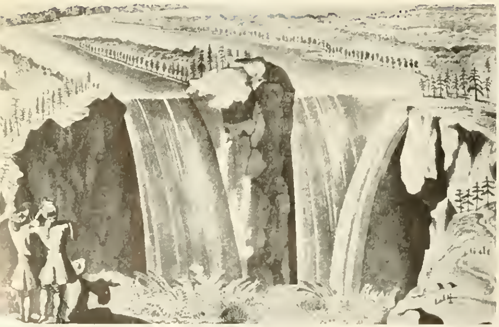
Among the phenomena of waterfalls and river gorges, the Cataract of Niagara is justly regarded as holding first rank, and as standing an index in the path of time, by which the numberless ages upon the surface of our planet may be recorded. Its present, its former and its prospective conditions have engaged the investigation and the speculation of many philosophers. The possible consequences of its entire reduction, and the drainage of the upper lakes have excited the wonder and apprehension of many. The estimated time of its recession has sprinkled grey hairs among the fresh locks of the young and blooming earth, and alarmed those who would still consider her youthful in years.—James Hall, 1843.

When the rain drips from the roof of your house, you are probably not aware that it is wearing away the edge of the roof over which it falls as well as actively eroding the ground below. But when million of gallons of water pour over the edge of a waterfall, it would seem certain that the edge of that fall as well as the basin into which the water plunges is going to be actively cut away. And there is every evidence that such waterfalls are worn back. In the case of Niagara Falls the evidence consists not only of the long gorge below the falls—a gorge extending for seven miles to the cliff face at Lewiston and Queenston Heights—which was cut as the falls were worn back from their original site where the river first plunged over that cliff. It also consists of the large pile of broken blocks at the foot of the American Falls, and of the large rock falls which occasionally modify the face of the falls and are topics for newspaper report.

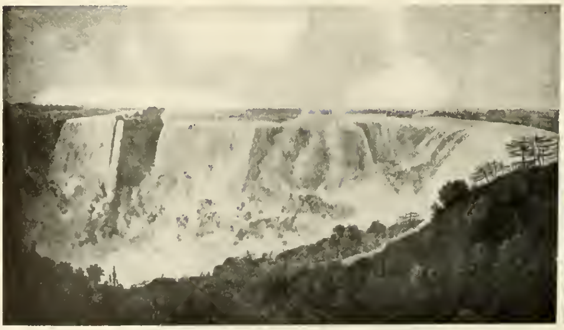
Less striking, perhaps, but more graphic in its im-

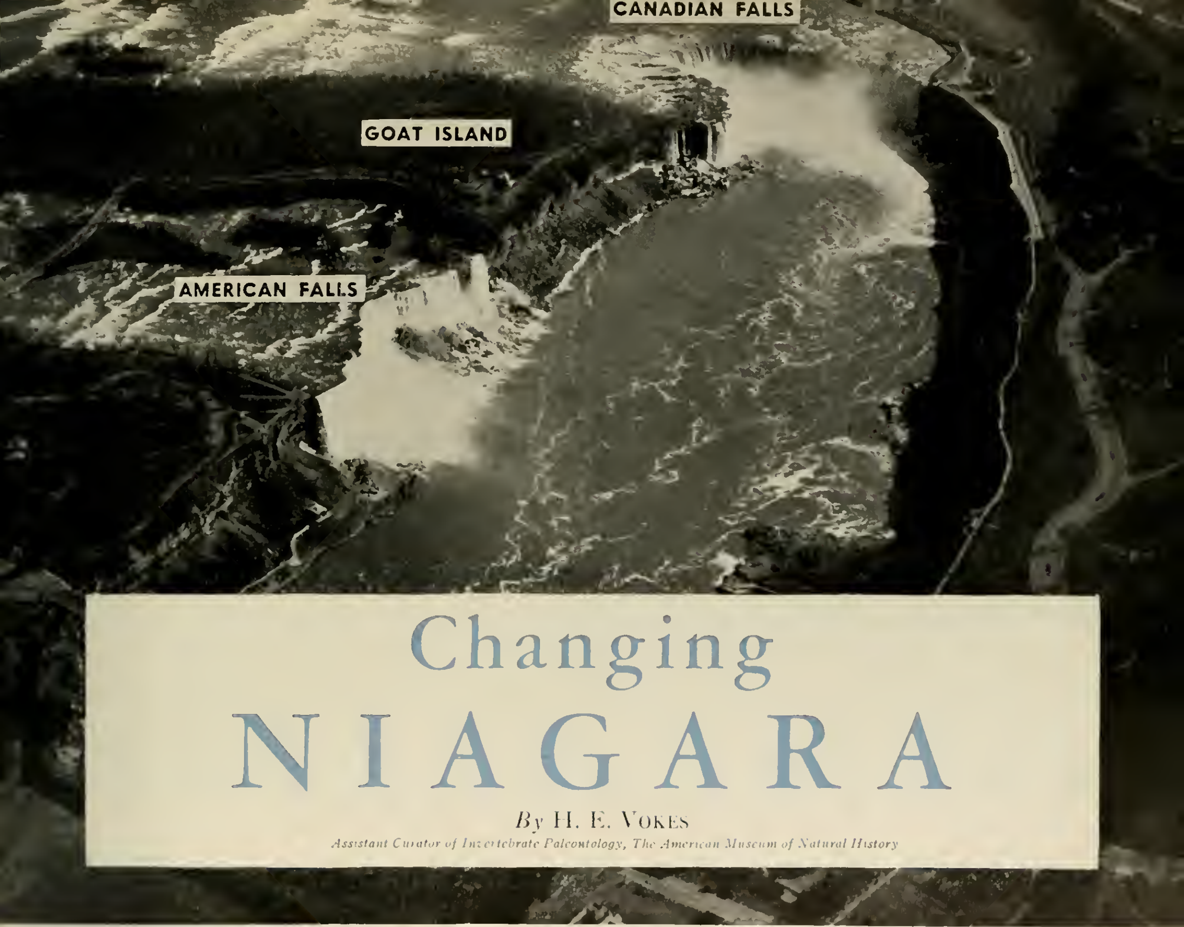
Horseshoe Fall is retreating much faster than the American fall, as shown by comparing the 1842 positions on the diagram at left. This is because more than 95% of the water goes over Horseshoe Fall. In time the Canadian branch of the river will cut back past the upper end of Goat Island and capture the water that now goes over the American Fall, leaving the latter dry

1678



1764





Changing NIAGARA

By H. E. Vokes

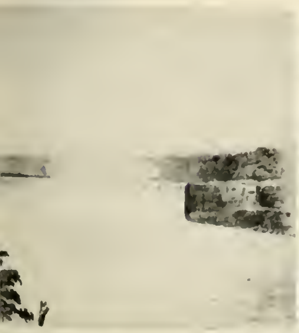
Assistant Curator of Invertebrate Paleontology, The American Museum of Natural History

Keystone View Company

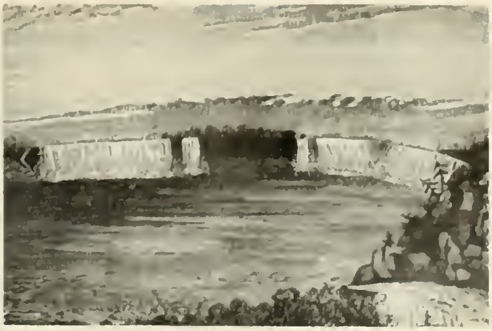
(Above) A RECENT PHOTOGRAPH, showing the whole geography of the falls area. Note the huge pile of broken rock at the foot of the American Fall which resulted from the rock fall of 1931

port is the evidence gleaned from a comparison of the crest line of the present falls with that shown by the many surveys of the crest that have been made in the past. It is interesting to note that it is exactly 100 years since the first accurate survey of the entire falls area was directed by James Hall, the famous geologist quoted above. This enables us to measure the extent to which the falls have receded during the past 100 years. Plotting the crest lines shown by the Hall survey as well as those of several of the numerous surveys made within the past century leaves no doubt that Niagara is being worn back, and at a rate that surprises most persons. It also shows clearly that the Horseshoe Fall is retreating much more rapidly than the American one. The reason for this difference in the rate of erosion is clearly understood when we realize that more than 95 per cent of the water passes over the Horseshoe Fall, while the remainder, less than five per cent, is so spread out that the deepest water at the crest of the American Fall is only three

1819



1842



1875

and one-half feet deep, and the average depth less than eighteen inches. The depth of the water at the crest of the Horseshoe Fall is not certainly known, but in the deepest parts must be about 20 feet.

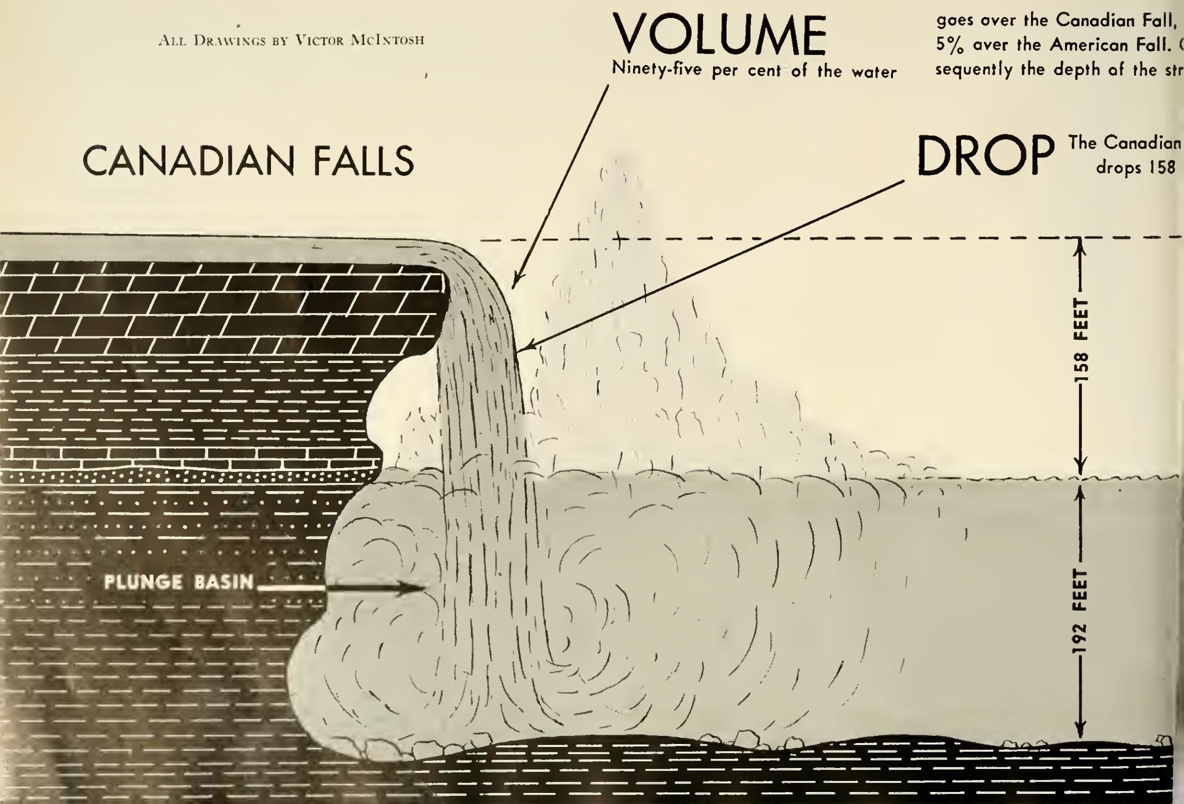
The "mechanics" of the recession of the crests is made clear by an understanding of the sequence of rocks over which the water pours. The uppermost layer, forming the bed of the river above the falls as well as the actual crest of the cataract itself, is a hard, massively bedded lime rock, known as the Lockport Dolomite. This layer is about 80 feet thick and is relatively resistant to erosion. But it is underlain by a series of soft shales and sandstones. There is a relatively thin zone of harder strata just above the water level below the Horseshoe Fall, but the beds under it, which form the wall and the bottom of the plunge basin are again of soft easily eroded rock. In other words the falls are capped by a "roof" of hard limestone overlying a whole series of soft rocks. As a result the water glides over the hard edge of the roof and falls with terrific force on the soft "ground" below, which is very quickly worn away and is scoured out by the action of the currents set up by the falling water. This rapidly undercuts the resistant "roof," encouraging it to break off as large blocks. The blocks fall into the pool where the turbulence of the water spins them around and around like a stone in the mill. Spinning in this fashion they tend to grind away the soft wall and further undercut the edge of the roof. This is the origin of the spectacular rock falls as well as of the slower, but more inexorable and constant erosion of the entire crest.

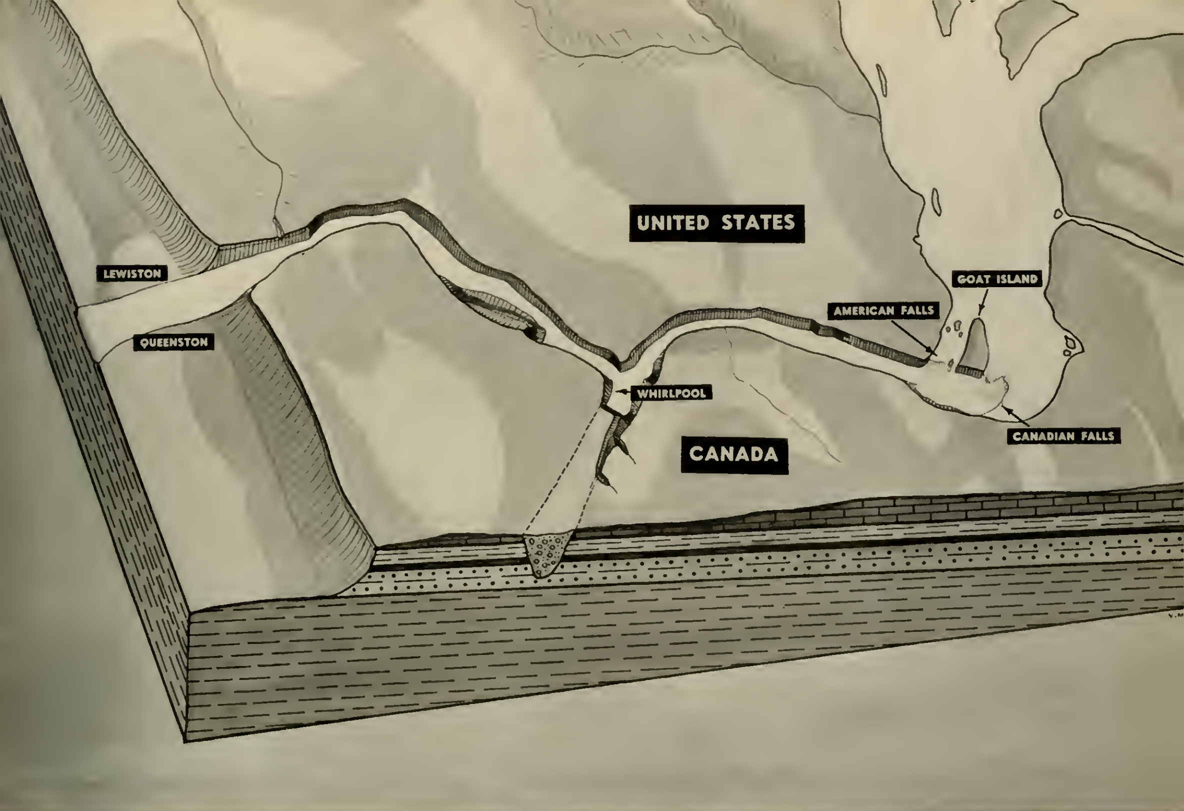
The rate at which the erosion occurs is more difficult to determine. In the case of the American Fall, the rate is relatively slow, only a slight fraction of a foot per year, a rate probably not much greater than that which would occur under normal weathering along the crest of any cliff so sharp and abrupt. The rate for the Horseshoe Fall is much faster. In that part of the fall where the water is deepest the falls apparently retreat almost six feet per year. Toward the sides and in those other parts of the crest where the water is shallower, the recession is appreciably slower, so that the average rate for the entire fall is about four and one-half feet per year. This has been calculated by a number of close students of Niagara, notably by the late Dr. G. K. Gilbert of the United States Geological Survey and Professor J. W. W. Spencer of the Geological Survey of Canada.

Knowing this rate of recession, it would seem quite easy to calculate the age of the falls, since it is known that they began with the first fall of water over the edge of the cliff bordering Lake Ontario near Lewiston and Queenston. Such calculations were commonly made in the days before we became aware of all the factors which complicate such determinations. The

THE FALLS are due to a hard layer of rock, the Lockport Dolomite, which forms the brink. The rate at which the falls retreat is governed by the softness of the underlying layers. Swirling currents eroding these layers undermine the cap-rock, causing it to break off. Owing to the gradient of the river bed above the falls, Niagara will become higher before it becomes lower, but it will eventually degenerate into a series of cataracts as do all falls

ALL DRAWINGS BY VICTOR McINTOSH


VOLUME
Ninety-five per cent of the water
goes over the Canadian Fall,
5% over the American Fall.
sequently the depth of the str
CANADIAN FALLS
DROP
The Canadian
drops 158
158 FEET
192 FEET
PLUNGE BASIN

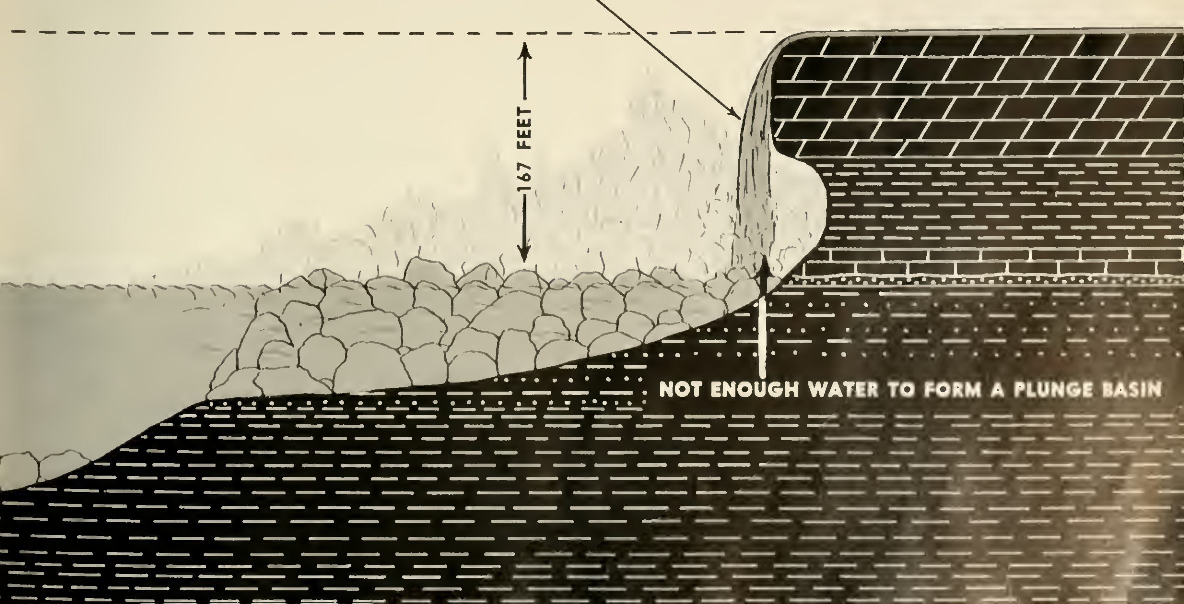

UNITED STATES
LEWISTON
QUEENSTON
GOAT ISLAND
AMERICAN FALLS
WHIRLPOOL
CANADA
CANADIAN FALLS

Modified from G. K. Gilbert

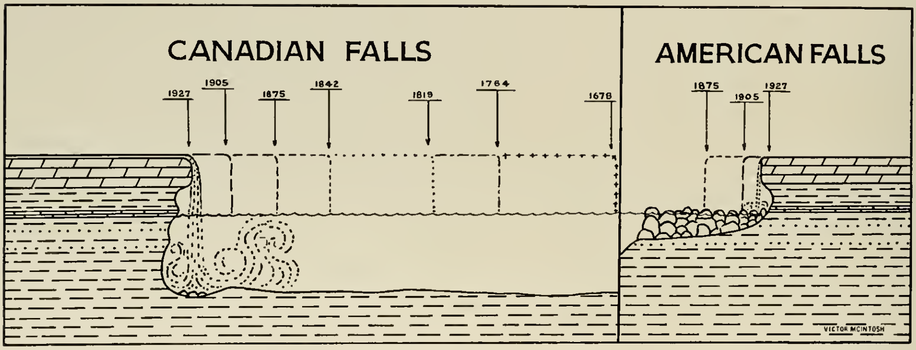
the crest of the American Fall rages only eighteen inches and ches a maximum of but three and one-half feet. On the Canadian Fall, the stream is probably 20 feet deep at the deepest parts

a plunge basin 192 feet deep. American Fall, though it is 167 feet high, does not have enough water to form a plunge basin

AMERICAN FALLS


167 FEET
NOT ENOUGH WATER TO FORM A PLUNGE BASIN

most significant of these complications are caused by the history of the Great Lakes themselves. Today Niagara receives all of the water from all of the upper lakes of the Great Lakes system. But such has not always been the case, for there was a time when all of the lakes above Lake Erie drained out through a channel passing from Lake Huron through Lake Nipissing and down the Ottawa River. During that time, Niagara received only the water of Lake Erie itself, and had only about fifteen per cent of its present volume. The rate of recession would, of course, have been much slower.



A CROSS SECTION shows that since the first white man viewed it, Horseshoe Fall has cut back a distance over seven times as great as its height. The American Fall has receded but little in comparison

On the other hand, the river cut one section of its gorge into what was the glacially filled channel of an older river. The hard, resistant Lockport Dolomite had already been removed from this area, so it is probable that the rate of erosion was greatly accelerated here. The section referred to includes the whirlpool and the gorge immediately above it. The old pre-Niagara River had previously cut across country to empty near St. David, Ontario.

Because of these and other complications, the period of time required for the cutting of the whole gorge cannot be accurately stated. But many tentative determinations have been made. These range all the way from 5700 to 100,000 years. The latest and most considered estimates seem to agree that Niagara Falls has been a spectacle of scenic beauty for about 20,000 to 25,000 years.

And how long will the falls continue to exist as a scenic attraction? That again is a question for speculation, and no entirely accurate estimate can be made. It is certain that the faster rate at which the Horseshoe Fall is receding will eventually cause it to cut back past the end of Goat Island and capture for itself the water which now passes over the American Fall, leaving the latter a dry monument to its present glory. It is also certain that by the time the Horseshoe Fall has reached this point it will, because of the gradient of the river bed, be some 40 to 50 feet higher than it is today.

On the other hand, the Lockport Dolomite dips toward the south, and thickens in that direction to a maximum of about 150 feet, before it passes under a softer overlying formation. As the Lockport becomes thicker it will probably be more resistant to undercutting and the rate of recession of the crest may tend to become progressively slower. Even after the crest reaches the place where the Lockport is overlain by the softer rock, the Lockport will probably continue to form the brink, for the softer rock will be easily eroded away; and the falls will then tend to become progressively lower and lower as they recede. Eventually the level of the crest will approach that of the river below the falls and there will no longer be any Niagara as we know it today. Instead there will be a tumultuous series of rapids and low cataracts dashing through gigantic blocks of tumbled stone.

It is difficult to estimate how long it will be before this will come to pass. It seems safe to suggest, however, that Niagara is only in the middle of her long and spectacular life and that tourists will revel in her beauties for thousands of years to come.

> But amid all these speculations Niagara still remains; the thunder of its cataract still reverberates through its chasms, and its ocean of waters still rolls on as, unknown to the white man, it rolled a thousand years ago.
>
> —JAMES HALL, 1843.

VANISHING *Eden*

By MARTIN BIRNBAUM

Pages from a journal describing a voyage to the ever-fascinating isles of the South Seas, replete with shipwreck, exotic feasts, and discerning observations on Man and Nature

ALL PHOTOS BY THE AUTHOR

It seems only yesterday that Charles Ricketts, perhaps the most cultivated man I have ever had the good fortune to know, urged me to throw over everything and sail away to the great temples submerged by fantastic jungles and the waters of the Mekong, to stand beside the monstrous figures on Easter Island, watch the blood-red sun setting over waving fronds on coral atolls, and renew our youth in the exotic company of gentle Polynesians.

Ricketts, alas, never realized these dreams; but I vowed that I would follow his advice and take a spiritual bath among the legendary isles made famous by Melville, O'Brien, and my friend Robert Flaherty.

When our boat eventually anchored in the harbor of Papeete, after a ten-day trip from San Francisco, the first native to come on board was Paré, otherwise known as Johnny Gooding, the son of the immortal Lovaina, a leading figure in O'Brien's *Mystic Isles of the South Seas.* His huge frame broke through all barriers to superintend the removal of the luggage belonging to some shipboard friends, and he condescendingly invited me to live with them beneath the leaking roof of his informal "Annexe."

This building would have been attractive had its original thatched roof not made way for an ugly one of more durable corrugated iron. It stood on a road which ran so close to the shore that at certain points it was lapped by the waters of the lagoon. Such essential comforts as doors, curtains, and mosquito nets seemed superfluous to our landlord, and one was embarrassed to find that privacy was not at all valued in Papeete. Not only our ablutions but our entire private lives were open to the gaze of prying guests who occupied adjoining bedrooms and even to promenaders on the footpath below. Strange indeed were the scenes we witnessed when candlelight lit up the bedrooms of this unique hostelry! However, you had to ignore formalities as well as wasps and huge benevolent mosquito-eating spiders if you wanted to enjoy Paré's hospitality, his luncheon parties, and his slightly salacious dancing, which was still very skillful, despite the quantities of adipose tissue which his frame supported.

TAHITI. The palm-fringed beach at Arue is of smooth black sand, volcanic in origin. Here land crabs scoot to safety when morning bathers come down to plunge in the crystal surf

Holes and cracks were everywhere in the Annexe —some for wasps and spiders, and others for the little geckos which caught their prey near the electric lights. The house was almost wholly surrounded by a balcony, on which we spent most of our free hours, and from rickety armchairs, we could watch the endless parade of the world of Papeete pass in review below us. There were stranded jet-black Solomon Islanders with scarified faces, who had been "blackbirded" by ruthless Germans in search of cheap labor. French officials in braided uniforms contrasted with bedraggled beachcombers. Negroes from Martinique, Annamites under circular, conical straw hats, and many Chinese who were shopkeepers in Papeete, mingled with half-castes of all shades. Everywhere we saw the barefooted Polynesian women with their leisurely movements, velvety brown skins, and the peculiar charm that has drawn generations of Europeans to the South Seas. Beautiful women have indeed always played an astonishing role in the history of these islands, which still remain essentially matriarchal in social organization. The native homes were built on a raised paved stone terrace called a *paepae*, and they sat there like professional beauties to be admired by passing strangers. On certain festival days they swam in the surf for the edification of the populace. If a powerful chief coveted the lovely wife of another ruler, he indulged in the quaint custom of borrowing her for a brief period. Many wars were fought over the charms of the marvelous Polynesian ladies. In the absence of brothers they inherited property and chiefly titles, as did the sovereigns of some European countries. Such chiefesses were independent of their husbands and had seats or thrones near the altar in the maraes, or sacred walled enclosures.

Shopping for breakfast

Paré did not serve meals, except for the simplest of French breakfasts, so we bought quantities of fruit to enrich that light repast. To do so we were obliged to rise before dawn and join a good-natured crowd in a barricaded market square. Exactly at sunrise, a cannonshot reverberated through Papeete, and the barriers went down. There was a mad scramble by the prospective customers for their favorite booths, and late-comers got little if anything. Choice items disappeared in a jiffy from the counters or crates, and then groups of gossiping shoppers would start leisurely for their abodes. The rainy season was just over and every road was gay with beautiful varieties of hibiscus, delicate abutilon, lively yellow allamanda, masses of bougainvillaea, and oleander, flaming cannas, hedges of coleus, lantana shrubs (which are a troublesome but handsome nuisance in the tropics) jasmine, coralita and passionflower vines, strange sensitive plants, exquisite Madonna lilies and frangipani to saturate the morning air with marvelous penetrating perfume.

Entertainment without program

Our lunches and dinners were obtainable at the French pension "Diadem," at the club known as the "Cercle Bougainville" (named after the French explorer), and at the late Lovaina's Polynesian restaurant, called the "Tiare." Now and then we would be regaled at a native feast, where we consumed quantities of tiny oysters seasoned with limes, fresh-water shrimps, crabs, guava in coconut cream, poi, sweet potatoes, *tai oro* (grated coconuts mixed with pink shrimp fat), banana fritters and chicken in turmeric sauce. Our favorite regular meeting place was Moo Fat's noisy, hilarious Chinese rooms. Aside from getting delicious almond chicken to eat, one never knew what adventure to expect there. It was a rendezvous of the sailors from the French fleet, and the singing mariners were usually accompanied by amorous Tahitian belles who were good dancing partners. In the course of a meal a jealous suitor might start a gory fracas which a Hollywood director would give his eyeteeth to see. Broken bottles would fly about in the ensuing scuffle, skulls of rivals were cracked, faces were scratched, blood flowed freely, women screamed, police whistles blew, and scattering Orientals vanished magically from the scene. But when the pandemonium ceased, the denizens of the district quietly emerged from their hiding places and wended their way nonchalantly to Papeete's unique cinema palace, known as the "Theatre Bambois," a place of amusement even noisier than Moo Fat's.

Here the audience came and went ceaselessly. A lusty announcer explained the action to the natives and he had to shout loudly to be heard above the musicians, the laughing children, dozens of snarling, barking dogs, and the tireless food hawkers stationed just beyond the entrance. Situations which we accept calmly arouse strange emotions and reactions among Tahitians, for their social conventions differ violently from ours. They would, for example, scream hysterically with laughter during a sentimental scene in which Mary Pickford's youthful swain would lean over a rustic fence to kiss her,—instead of rubbing noses. The hall did a thriving business and was always crowded, unless there was some free rival attraction, such as a public ball given by some rich American yacht owner, who would invite all Papeete to a huge party. Such gatherings were extremely democratic. We could dance with royal princesses of doubtful reputation, who looked like pretty New

York Jewesses and were actually descended from Salmon, an English Jew, who had married into King Pomare's family. Some women came in European ball gowns, while others wore cotton Mother Hubbards. There were men in dinner jackets and white gloves, but some had no collars. A few waltzed in patent leathers, others were barefooted. Whites, Negroes, half-castes, and Polynesians, aristocrats and prostitutes,—all mixed freely. Apparently no social distinctions were observed, and I now regret that I never had the patience or fortitude to remain to see one of these strange bacchanalian parties in its last early morning stages.

Our daily routine called for a glorious morning swim at Arue on the palm-fringed beach of hard, smooth black volcanic sand, over which the land crabs scooted when we ran to dive into the pounding breakers of crystal-clear water. After a siesta, we might go to Point Venus, where in 1769 Captain Cook had observed the transit of that planet, or walk through the jungles along a moist path alive with black-and-white "mourning" butterflies to a secluded, romantic glen where a primitive stone relief, about four feet in width, lay hidden under wild taro leaves and maidenhair. It may be related in some mysterious and still unexplained way to the sculptures on Easter Island. Its phallic nature was obvious and showed a complete nude figure with outstretched arms. Natives who knew of its existence feared to approach it. To them it was taboo—like King Pomare's tomb, a visit to which, they said, cursed the unwary by afflicting them with leprosy.

Waterfall

On another tramp we were rewarded by a fine view of the famous Fautaua waterfall on the opposite rim of the plateau. Like a silver ribbon it fell in an unbroken leap of about 600 feet into a limpid pool below. Here mothers washed their babes a few hours after they gave birth to them, and later taught the children to become remarkable swimmers. In this and other localities, we collected and compared many specimens of pretty land snails (Partula) differing slightly in shape and color but obviously descended from one parent stock.[1]

It so happened that our stay in Papeete coincided with the Fourteenth of July celebrations, and the French administrator arranged competitions of communal dancing and himene[2] singing for prizes. If only he could have decreed that correct ancient native costumes be worn by the participants! During the day French sailors raced against stalwart native oarsmen, and Queen Marao gave an informal reception to dancers and victorious Tahitian athletes.

The queen was a colossal woman, with an unmistakable personality. She wore goggles, a masculine straw hat, and the usual Mother Hubbard, but made of black silk. With one of her daughters, she received her patriotic subjects in the back yard, and I noted with surprise that the nonchalant young men who brought offerings of squealing pigs and clusters of *feis,* or wild bananas, did not remove their hats and even spat in the royal presence. The queen's father was the Englishman Salmon, mentioned above, and her title to the throne was derived from King Pomare, her deceased husband, who had divorced her. Gossips said that the royal couple lived together only one day and that the king, having secured a divorce, celebrated his freedom by incessantly singing the popular tune, *E Maururu Avau* ("I am so Happy"). His family history and many legends surrounding Tahitian royalty are told in a rare privately published book,[3] written, surprisingly enough by the famous Henry Adams, author of *The Education of Henry Adams*, after legends related to him by the queen and an old chiefess.

When the patriotic festivities ended, we were free to start on a circuit of the island in a rickety antique buggy. It was a hazardous but scenically attractive trip. Tahiti is mountainous and volcanic and is divided into many narrow valleys. Although snakes do not exist in this paradise, its Creator might be suspected of having some grudge against the islanders, for there are other more sinister invisible dangers. While bathing, care has to be exercised, for coral scratches may cause blood poisoning, sometimes with serious results. There are venomous sea creatures which one must avoid. Leprosy and especially repulsive forms of elephantiasis are common scourges. Over and over again we came upon men and women who were almost helpless, disfigured wrecks, with gigantic organs or limbs. The victims, in cases not too far advanced, can be cured by operation or by moving to cool northern countries. Meanwhile, the sufferers go about doing their daily chores uncomplainingly. Loathsome skin diseases are also an ever-present brooding danger which take their toll of the natives.

In the course of this expedition we stopped at Tautira, where Robert Louis Stevenson had lived; and from time to time we visited some artists and authors who were seeking to escape from the sophistication of white civilization, as Gauguin had done. Chief among these men were Robert Keable, author of *Numerous Treasure*, and "Borneo" Smith, a venturesome traveler who tried to transform a tract

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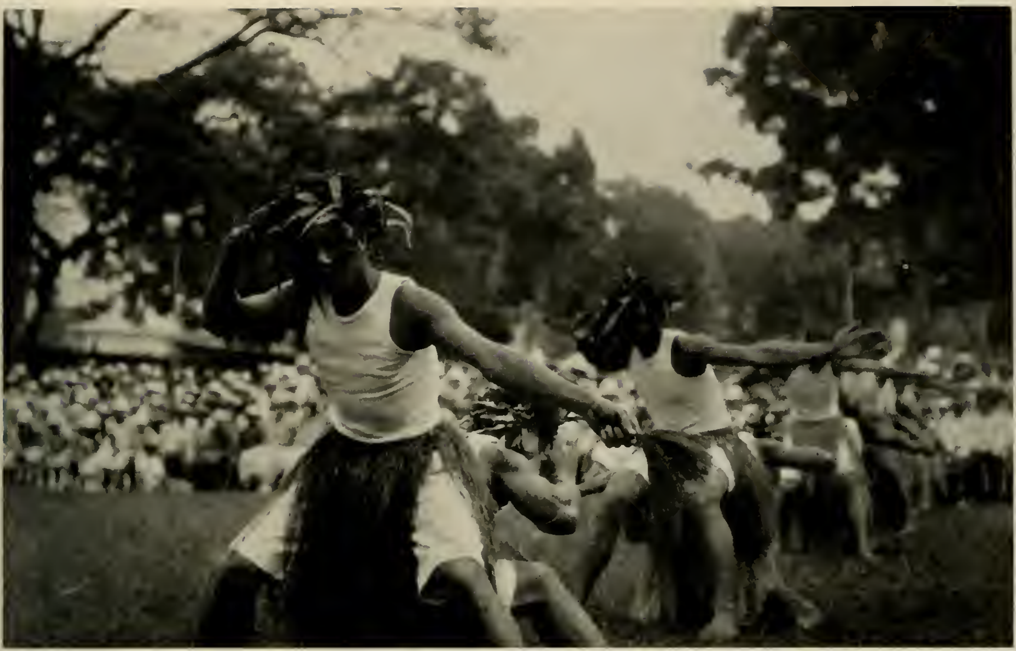
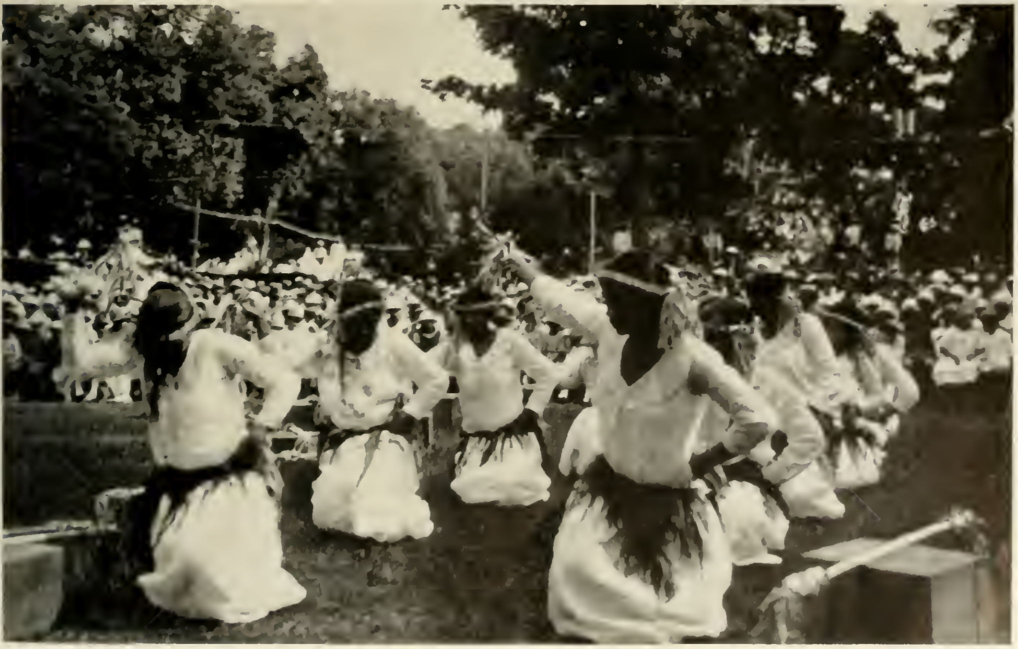
[1] The effects of geographic distribution and isolation on this genus are beautifully shown on a large relief map of Tahiti in a special exhibit at the American Museum of Natural History.

[2] Though not hymns, the songs thus designated in pidgin English have borrowed the name from our word.

[3] *The Memoirs of Arii Taimai e Marama of Eimeo Teriirere of Tooarai Terinui of Tahiti Tauraatua i Amo* (Paris, 1901).



(Above and below) COMMUNAL DANCING on the Fourteenth of July, national holiday of French-governed Tahiti. Athletic boys and white-clad girls enter song and dance competitions arranged by the administration



(Left) LIKE A SILVER RIBBON, the Fautaua waterfall leaps approximately 600 feet down the craggy volcanic slope. In a clear pool at the foot of this cascade, mothers wash their babies a few hours after birth and later teach them to become remarkable swimmers. The funnel from which the falls spring into space is plainly visible

(Left) NEAR Robert Louis Stevenson's Tautira lies this view of the Vaitapiha River. Many artists and writers have found refuge in Tahiti from the uncongenial atmosphere of civilization. The French painter Paul Gauguin is one of the most celebrated of these, but there have been numerous lesser lights. Of our contemporaries, Nordhoff and Hall, the popular fiction team, are perhaps the best known Tahitian expatriates. In times gone by this mountainous island produced native types of great physical beauty, whose simple and happy life has since suffered under the conflicting attitudes of the white man

(Below, right) LANDING WHARF on Moorea. While fraternizing with the natives of this island near Tahiti, the author witnessed an impromptu moonlight dance of surpassing primitive beauty. But such spontaneous self-expression is becoming increasingly rare throughout the South Seas, owing to the inhibiting effect of white civilization and the resulting loss of many elements of the native culture. The white man has drained much color and variety from this world of waving palms, and given little in return

(Below) A TRANQUIL RIVER VALLEY near the coast of Tahiti, showing typical mist-shrouded volcanic hills in the background. The productive coastal region of this French possession yields coconuts, bananas, and oranges, as well as sugar cane, vanilla, and other tropical fruits

of land into a rank impenetrable jungle. O'Brien had already left the islands never to return, because his famous books, *Mystic Isles of the South Seas, White Shadows in the South Seas*, and *Atolls of the Sun*, were not favorites among Tahitians. Other settlers were Nordhoff and Hall, who have since become celebrated as authors of the books dealing with the mutineers on the *Bounty*. In an article which appeared in *The Atlantic Monthly*, Hall, who had married a charming native girl and was already raising a family, gave many convincing reasons for abandoning New England to contemplate existence among these South Sea Islanders.

Before meddling Christians disturbed them and introduced new diseases, the islands were compared to paradise! What have we given these people in exchange for the ancient ceremonious existence and the ancestral Polynesian code which we destroyed? Fed on the fiction that economic development would bring many advantages and blessings, the natives receive as their compensation for white injustices only another war! How can we expect them to believe in the beauties of conflicting faiths, sects, and conventions, which have brought such bitter fruits in their train? One particular experience of mine gave rise to many such tangled reflections regarding the benefits of our much vaunted civilization. One evening on the island of Moorea I was playing my violin on the beach for some native friends. After I stopped playing, a young, scantily clad dancer leapt into the air and executed one of the loveliest moonlit hulas, accompanied only by the lapping waves and the rhythmic humming and hand-beating of his friends. It was a glorious incident in a dream-like setting and gave me a hint of the passions beneath the stolid exterior of the natives. Suddenly a man's shadow was seen in the palm grove and the dancer stopped as if stricken, the boys scattered hastily, and there was no more music that night. The "shadow" was a missionary whom they feared like a plague! Let no one who has read Somerset Maugham's *Rain* assume that Mr. Davidson is merely the figment of a novelist's imagination!

When we left these gentle people they smothered us with leis of flowers, seeds or shells, and rubbed noses with us affectionately. Knowing that I loved flowers they had given me a native name, "Motoe" (*Mos'oi* in Samoan), after the ilangilang, the tree of perfume fame. As we steamed from the harbor to sail for Fiji and thence to Samoa, the crowd on shore sang their mournful himenes, and I felt wistfully that I was leaving real friends whom I might never see again.

Samoa

Flaherty had warned me not to expect too much of Samoa after the colorful vegetation of Tahiti, and when we entered the deep, narrow, protected harbor of Pago Pago the somber mountains, to which rain clouds clung, seemed to shut out the sunlight.

Unless a visitor is a guest at an American official's home, he is practically obliged to take shelter under the roof of the notorious little hotel made famous by Somerset Maugham in his brilliant story, *Rain*. Its miserable balcony faces the dominating peak called the "Rainmaker," and it is conveniently near to the groups of native houses, which have ovoid hemispherical thatched roofs supported by trunks of trees. We saw no abodes as beautiful as the chief's on the island of Bau in Fiji, but the owners took great pride in these homes, and in their precious heirlooms. They refused most generous offers for old fishhooks of bone, mother-of-pearl or tortoise shell, and strange hooked knives with handles held together by brass.

Naturally we paid our respects to the American governor and the lesser officials. One night a young lieutenant, armed with a sharp three-pronged stick, took us on a centipede hunt. These dangerous myriapods are from six to eight inches long and very poisonous. You probably will not find it in the books, but a curious thing was pointed out by the lieutenant who was with me. "You will see something remarkable happen every time we kill one of these," he said. Then he demonstrated. Each time we attacked one of the myriapods, a second one rushed out of the grass and attacked the forked stick. I was told that this invariably occurred. Large scorpions are also fairly common. Birds are rare, and I never saw any on a long ride along the road running close to the beautiful shore, white with breaking rollers. We passed great numbers of the widely distributed monarch butterfly, but a moving vehicle is not a good vantage point for making notes on natural history. Nor could we linger in the villages of Leone and Hunli to study house-building and the making of tapa, for we were afraid of missing the boat due to sail for Apia.

My main reason for coming to Samoa was to visit the village of Safune and meet the native actors who played the roles in Flaherty's *Moana*. Ever since I had seen the uncut version of that beautiful film, I longed to absorb the famous *Fa'a* Samoan spirit in their company. Fialalei, the charming English-speaking interpreter who ably assisted Flaherty, had already met me at Apia, and she told me where to look for her brother, Arthur Yandell, on the island of Savaii, where the motion pictures were made. It is the largest island of the Samoan archipelago, and suffered from a catastrophic volcanic upheaval which destroyed vast tracts. The visit involved an all-night trip on a tiny steamer to the village of Fagamolo and a drive with an interpreter to Safune.

As we passed through the open country I was hoping that I might at least see a specimen of the disappearing Didunculus or tooth-billed pigeon, which reminded me of the extinct dodo. It lives only on the islands of Savaii and Upolu. I was told that it is still found, but its habit of building its nest near the ground makes it an easy prey for larger rodents. Not only was my ornithological ambition never attained but our rig broke down and we proceeded to Safune on foot.

A ceremony

The chief or *faipuli* was in council but, on seeing us approach and hearing that I bore friendly messages from Flaherty, the meeting broke up and I was greeted with an impressive but improvised *kava* ceremony, that peculiar feature of Samoan communal life. It took place in the fine house of crafty old Moana (not Flaherty's hero but the man who played the role of the benign father).

We sat politely cross-legged on mats in a circle around the chief with our backs against wooden pillars supporting the roof. A taupo, or ceremonial hostess of the village, who is always the lovely virgin daughter of a chief, made the *kava,* assisted by her attendants. They chewed small pieces of the root of *Piper methysticum* after carefully washing their mouths. A young chieftain, who is the guardian of the taupo and responsible for her virtue and safety, sat near the young girls. Heaven only knows what exalted station in life they thought I graced, and while my fictitious titles were recited aloud by the chief's spokesman or *tulafale*—a tall, magnificent embodiment of his race—, the chewed roots were mixed with water and prepared for drinking.

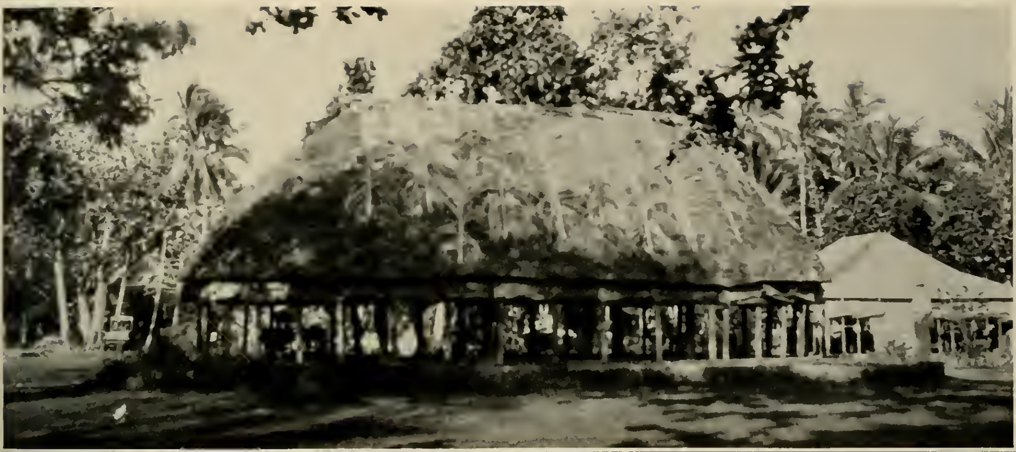
The ceremony can be compared to tea-drinking in Japan. As their guest, I was the first one served, and nothing could excel the grace with which the enchanting taupo handed the coconut cup to me. Fortunately I remembered Flaherty's picture of such a scene and before I tasted the libation I called out "Manuia" and showed my respect for their gods by first pouring a few drops on the ground. My gesture evidently met with the surprised approval of the assembly. The beverage looks like water in which putty had been dissolved. I had already been introduced to it and rather enjoyed its slightly acrid taste—something like bitter almonds seasoned with pepper. I knew that it would revive and refresh me after my long fatiguing walk, although too much of it will make your legs unsteady. After the cup had passed the round of all those present, the ceremony was repeated, and complimentary speeches were in order. In responding to the *tulafale's* toast, I told them about the great distance I had come and described the skyscrapers of New York, besides thanking them for the pleasure that Robert Flaherty's picture was giving vast audiences throughout the white man's world.

(Above) A **Samoan** native house under construction

On returning to Apia, I learned to my consternation that a slight influenza epidemic was threatening that district as well as Pago Pago. This would mean quarantine and serious delays, and the sole opportunity to avoid these was to catch the steamer *Ventura,* leaving the American harbor for Hawaii, before the health restrictions would become more drastic.

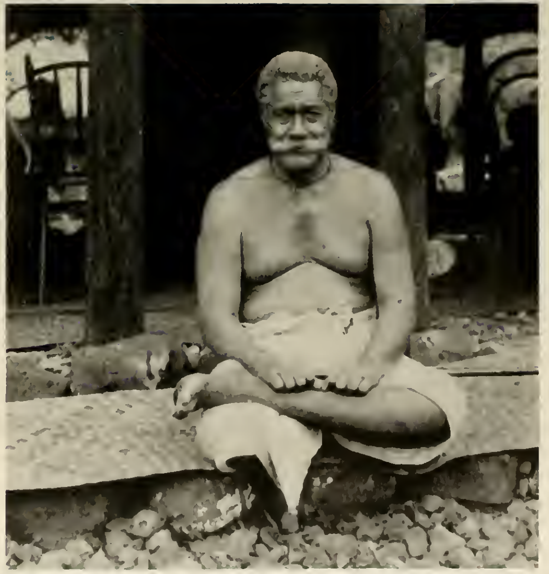
The only available boat was an eight-ton trading vessel, the rudder of which, so it was whispered, was in poor condition. We had no lifeboat or barometer. Threatening black banks of clouds on the horizon seemed to block our way when we started, and trailing wisps of smoke lay close to the surface of the bay; but we were told to have no fears of dirty weather because our finely tattooed captain Billy Hicks and his crew of two boys knew the treacherous waters and every inch of reef and coastline. There were no cabins so we made room on the deck among the oilcans and bags of cocoa for some mattresses loaned to us by considerate English friends, who evi-

(Below) **Open walls** characterize the finished dwelling

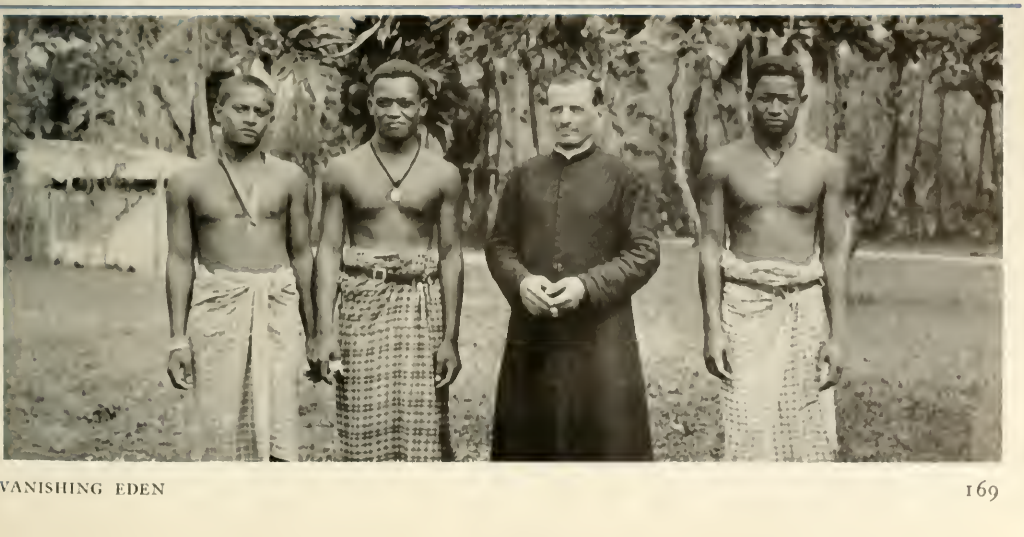


(Above) A RESTORATION of the house of John La Farge near Apia, Samoa. The artist shared quarters with Henry Adams, the renowned New England traveler and author

(Right) THE SAMOAN HIGH CHIEF who gave a reception for the author. He sits in front of his house in characteristic pose, left foot over the right knee



FATHER DUMAS, the priest at whose mission house the author stayed after he had been shipwrecked in the district of Aleipata. The three boys are fine examples of the Samoan physique



dently knew what ordeals might be in store for us. All went well while we were still in the lagoon, but when the curtain of tropical darkness fell and we reached the open sea, squalls blew up suddenly and it began to rain.

The viciousness of the gale caught Hicks by surprise. He was altogether unprepared for such an onset. As the boat sank to wallow in the trough of the sea, then rose and lurched from side to side, every movable thing on the deck of his vessel slid about, and the stationary items changed their slant to a terrifying angle. Soon fury was unchained and we were pitted against Nature's powerful forces. Bareheaded, defenseless, and shivering, I was holding firmly to the mast near the hatchway so that I would not be thrown overboard by giant combers and heavy cross swells. With my eyes shut most of the time to keep out the stinging spray, I felt precariously alone in the abysmal darkness, and in one of those strange moments which come to us all when our lives are at stake, I reviewed my entire career from early childhood. The force and rush of the mighty winds increased, and when I opened my eyes for an instant, I could see that we were dangerously near to the rocky shore. My fellow passengers were already too seasick to realize fully our peril, and to my dismay I saw that our captain and boys were trembling with an attack of the "flu." Finally, Hicks, a victim of fatigue and bodily misery, handed the wheel over to one of the boys and fell exhausted into a hammock which hung over the open hatchway.

There was no respite for him or for us. The hissing torrents of rain poured from the sky and the angry all-enveloping sea kept breaking over the helpless pitching vessel. It was a miracle that I was not swept away, but I knew that if I let go, I would find myself sprawling on the deck or lost in the swirling inky waters, so I held on tenaciously, hooked as it were to the mast. I shall never understand why we were not swamped in that stupendous storm. It tore violently at everything and shrieked exultingly while the hammering surf drowned the calls and warnings of my prostrate friends, who were avoiding the shifting oil-cans on the flooded slippery deck. Hicks, glaring madly at the elements, simply had to arouse himself and take up the hurricane's challenge. He called on all his reserve energy to take the wheel once more at this perilous juncture.

The *Tiafou* was taking in water through her seams. The leakage gained on us, although our sick boys kept baling and pumping all through the black night. Would Hicks lose control of the laboring vessel? He cursed and yelled as each wave made the groaning boat quiver from end to end. The strain was almost unendurable and his powers were taxed to the utmost. At last, he shouted to tell me that we had reached the district of Aleipata at the eastern end of the island of Upolu, a rich copra trading center; but it was no comfort to hear him burst out with an unprintable oath that we would never reach Pago Pago. Evidently the experienced old mariner did not think the boat could weather the gale much longer.

To the leeward, his restless eye had pierced the obscurity and he could distinguish a chain of volcanic rocks, against which the rest of us expected momentarily to be dashed. They stood like sentinels near the entrance to the lagoon at a point known as "The Cauldron," where the boiling, raging current rushed through the break in the great coral reef. Our slim chance was to find this opening, and now the captain's remarkable familiarity with the rock and reef formation stood him and all of us in good stead. Desperate but calm, he skillfully guided the vibrating *Tiafou* on the crest of a huge wave at the only possible moment, and while I braced myself against the mast, we were literally whirled into the sheltered and comparatively calm lagoon. The trembling *Tiafou* reeled but did not quite collapse. As soon as Hicks was sure that he had succeeded, he threw our anchor overboard, not knowing that the rotten ropes would break, letting us flounder and drift aimlessly about till dawn. Children discovered our benumbed party practically beached on the sands near the mission house of Father Dumas later that morning. We were safe, but stranded in Aleipata.

A native welcome

After we were made comfortable, the chiefs of the neighboring villages paid us visits and offered us food, shelter, and many opportunities to study the daily lives of our hosts. The men are the warriors, the hunters of wild pigs, the fishermen, the net-makers and the builders of houses; they also carved canoes and constructed boats.

The womenfolk were by no means household drudges, although they looked after the home and the kitchen. They wove baskets and plaited fans. They ornamented tapa cloth with designs cut on blocks of wood. They made vegetable dyes as well as oils and perfumes for the hair and skin. Lava-lavas and ornaments of shells or feathers were among the special products of their labors. Above all, they wove the celebrated mats of pandanus fiber. Months of careful hand-weaving were necessary to produce a really fine flexible mat worthy of a chief, and such mats became the most highly prized of all heirlooms. They formed the treasured items of the dowry of a princess, or the shrouds for the body of a deceased royal personage. A grateful chief might bestow one on the family of a skillful boat builder, architect, or tattooer, just as a European ruler might honor a citizen with a distinguished service medal. Some of these mats enjoyed local fame and were given explanatory names such as, "The mat finished in Saliusi" or "The mat woven on the deck of a vessel." Titles pass with their ownership as they do with jeweled crowns. Pitched battles have been fought for the possession of these symbols, and the legends surrounding them are told in the sacred books, which no Samoan dares handle irreverently.

Shortly after our arrival we were honored with a reception at the house of the chief, who was a relative of the great Mata'afa. He was a fine figure of a man, and had his skin been lighter, he would pass for a prosperous Wall Street financier. In the old days he would have been regarded as a demigod and would be carried in a litter by his people whenever he paid visits, for all land that his feet trod upon became his property. Speaking English hesitatingly, he received us very graciously, surrounded by his family and his *tulafale* or spokesman, served us with refreshments, and showed us the truly wonderful royal mats woven so finely that they looked like flexible brown linen. At this ceremony, men in place of a gentle taupo, made the *kava,* and the ritual was not as impressive as in the village of Safune. Nor were any of the feasts at Aleipata as lavish, for a recent storm had driven fish far from the coast and had ruined the breadfruit and banana crops, besides destroying poultry and cattle. They were expecting the swarming of the strange sea worm called the palolo (*Eunice viridis Gray*), which rises to the surface of the sea in unbelievable millions on certain nights of the year. Then the natives are kept busy collecting the slimy fragile annelids, in every available receptacle. In the meanwhile the villagers went hungry, and we, as American "millionaires," were expected to show our material appreciation of their hospitality by presenting each group with kegs of dried beef,—gifts which we bought from a white trader, who had a native wife and half-caste children. It was fortunate that the ancient *malaga* custom is frowned upon by the existing foreign laws to which the Samoans now submit. In the old days entire villages would roam about the islands paying ceremonious visits en masse to other villages. A *malaga* was like the descent of a cloud of hungry locusts on the unwilling hosts. The cost of the obligatory entertainment practically put the visited village into bankruptcy, and the only recourse or revenge was an unwelcome return visit.

A boat was leaving Apia in a few days for Fiji, and there we might catch another ocean liner sailing from Suva directly to Hawaii. So we were obliged to leave Aleipata on another little trading vessel, and we stopped at Fiji only to change steamers.

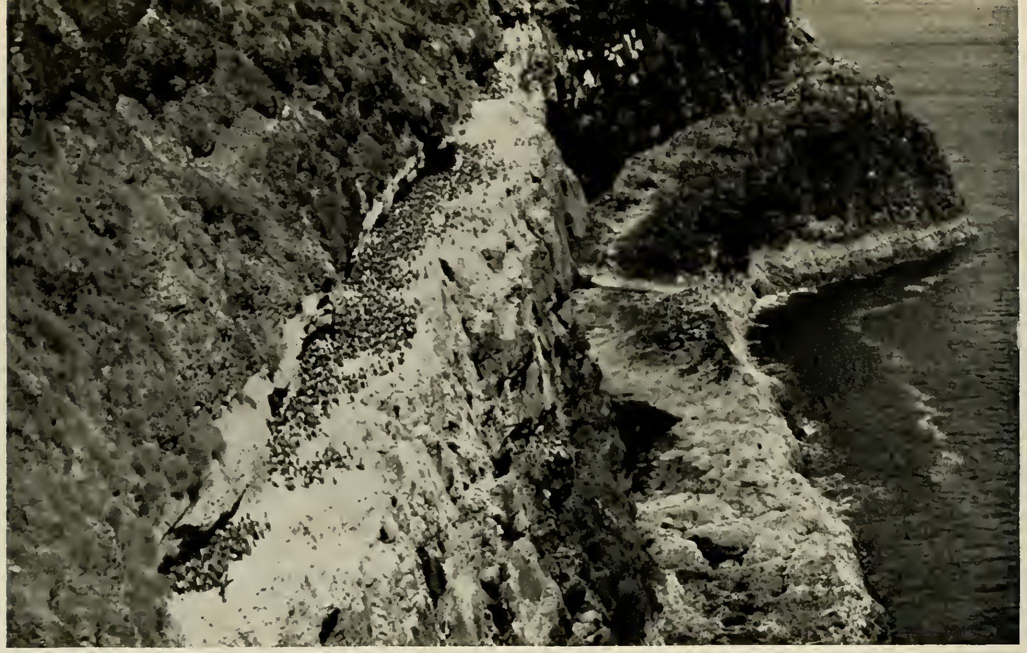
Farewell

At noon on the third day of the voyage north, we were treated to the last thrill when we passed Canton Island,—as perfect a coral atoll as one could wish to see. Far from any other land, it was almost a perfect circle of glistening sand, covering the work of the coral polyps. It was still a very young island, for only a few graceful palms swayed over the sheet of sparkling green water which it enclosed, and it was outlined by foaming white breakers. As it disappeared on the horizon, it served as a perfect symbol of the lovely regions we were leaving behind us. Here was an Eden still uninhabited, and the gentle Polynesians who might have discovered and settled it a century ago were vanishing. For months I had steeped myself in their views of life, and never again would I be scornful or contemptuous of the so-called "savage." Melancholy and alone on the deck of the *Niagara,* I sat recalling the scenes I had only recently witnessed in just such an environment, treasuring the still vivid impressions which had raised doubts in my mind on the wisdom of encouraging the march of white man's civilization. The mood of elation in which I started my voyages vanished, for I realized that I was stupidly returning to a collapsing world and the trap of modern industrialism from which I thought I had escaped. Already I knew that further disillusionment would only start me off again in pursuit of some new elusive goal. In the meanwhile I was transported in reverie to a feast where my handsome brown friends sat around their chief, a gentleman whose high rank no one could mistake although he wore only a pareu. Could a European ruler be recognized merely by his dignified bearing if seen dressed in nothing but a bathing suit?

Everybody greeted me with a cheerful "Ia ora na," and when I sailed away they sang their mournful himene, which roughly translated means:

> Farewell, my friends who leave to sail on the ship for America; do not forget Samoa, our land, and think of us, O passengers.

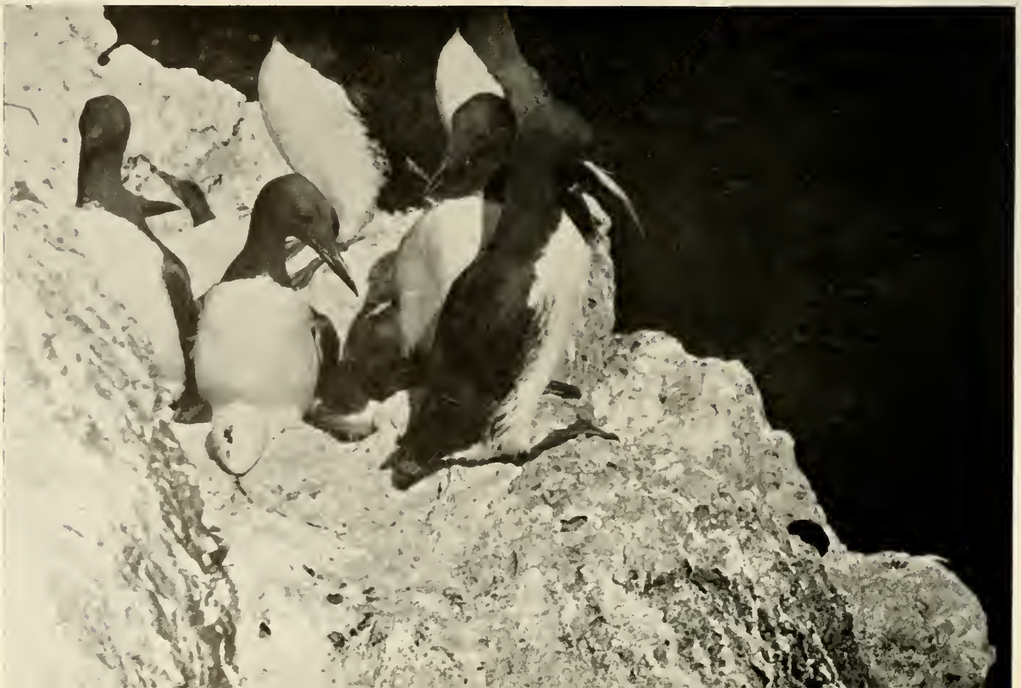
This article will soon be published in book form along with a number of other essays narrating the author's tropical travels, under the title *Vanishing Eden* (William F. Rudge's Sons, Publishers).



(Above) GALLERIES overlooking the sea on the face of Oregon's Cape Lookout provide a rather perilous "nursery" for the California murres which spend the first weeks of their life here

Californi

THE EGGS have brown splotches on a background ranging from grayish-white to bright blue. This detached colony of about 30 birds on an accessible ledge showed a high loss of eggs and decrease in numbers. By July 2, only about twelve birds remained and only four chicks and two eggs were in evidence. Depredations by gulls and disturbance by visitors were chiefly accountable. The birds engage in little fighting aside from mild sparring between close neighbors accompanied by raucous screams. The bird on the right has just returned with a small fish for its chick



MURRES

By William Graf

All photographs by the author

Cape Lookout, jutting three miles out into the Pacific on the coast of northern Oregon, is the home of several nesting colonies of California murres. Almost the entire south side of the cape is a sheer cliff, rising nearly 1000 feet at the highest point. Being practically inaccessible, most of the cliff face cannot be viewed except from a boat from below. The difficulty of photographing these birds proved rewarding, for it resulted in a fascinating record of their brooding, feeding, and social habits, as well as some of the dangers that confront them.

Probably one of the worst dangers the murres have to contend with is waste oil discharged by ships. Many of the birds were observed to have dirty, oil-smeared feathers, and dead murres with oil-matted feathers are common on the Oregon beaches.

The older murres, while stupid and indifferent in defending their eggs, showed considerable intelligence and anxiety in watching over their chicks. When a youngster wandered too near the perilous brink, the old bird would crowd in between and if necessary forcibly stop its progress by shoving it back with the bill. In one instance, a very young and still weak chick tried to cross a steep face of rock to another ledge after the old bird had been frightened away. When it began slipping down toward the brink of the ledge, its cries brought prompt response from the old bird. The latter worked its way out on the steep slope and got beneath the chick and tried to push it up. The footing was too precarious and the chick too weak to take advantage of this help. Finally the old bird also began to slip downward and had to abandon the chick, which tumbled over the edge into the sea.

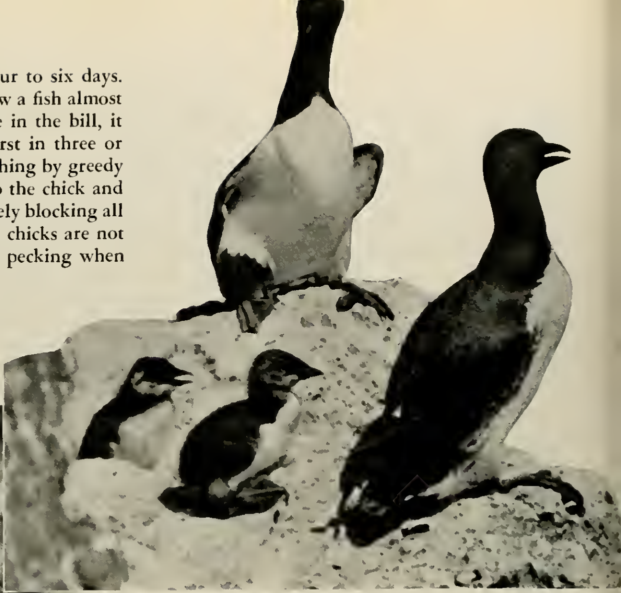
Aside from the egg-stealing gulls, about the only other natural enemies of the murres are the occasional duck hawks (Peale's falcon) which often nest on the lofty cliffs near large sea bird colonies.

Most of Cape Lookout's rugged terrain is covered with a dense stand of hemlock and spruce and an almost impenetrable, jungle-like undergrowth of shrubs and vines. To the windward a colony of murres can be detected for at least a half mile by its odor. At close quarters on a hot day and in the company of swarms of biting flies, the vicinity is anything but pleasant.

The colony pictured numbered between 800 and 1000 birds. To judge from the bedlam of noise and the incoming and outgoing birds, there are probably several other large colonies on ledges where they cannot be seen because of the overhanging form of the cliff. Farallon cormorants were common, nesting to a lesser extent than the murres, on the more inaccessible ledges.

One or two California gulls are always patrolling the edge of the colony for an unguarded egg. Lacking easy opportunities, a gull sometimes brazenly lands near a nesting group and, after a short sparring bout which is rather half-hearted on the part of the owner, literally snatches the egg from under the murre. The egg is carried only a short distance and then broken by dropping on the rocks. As often as not the egg rolls over the brink and is lost in the sea. In any case the gull's bill is rather poorly suited to taking up liquid, and much of the egg is wasted

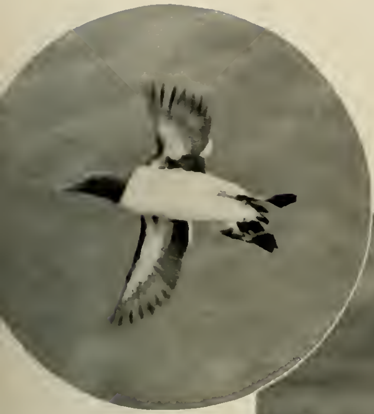
(Below) A TYPICAL YOUNGSTER of about four to six days. Though barely able to toddle, it could swallow a fish almost as long as itself. Receiving the fish crosswise in the bill, it would turn it quickly and swallow it headfirst in three or four gulps. Presumably to prevent food-snatching by greedy neighbors, the old bird would crowd close to the chick and protect it with partially spread wings, effectively blocking all efforts to photograph the procedure. Strange chicks are not tolerated by neighbors, who deliver a sharp pecking when they wander from their own nest spot



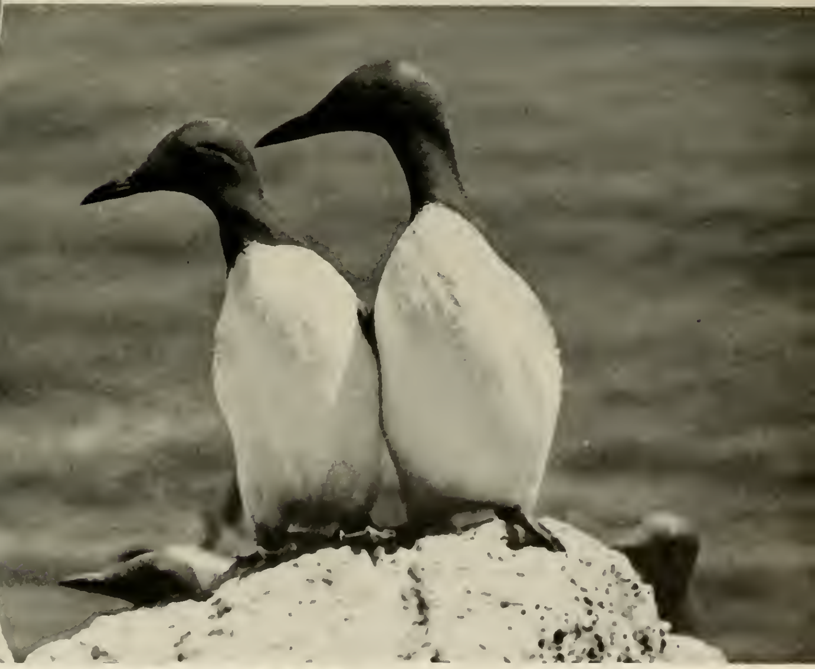
UNCERTAIN CHICKS three or four weeks old *(above)* sometimes fall off the cliff accidentally and were observed in the water below the nesting ledge. All were being led straight out to sea. They ducked and swam with ease; and when a chick dived, the old bird always dived with it. Most of the colony's young of this size made no voluntary attempt to take to the sea

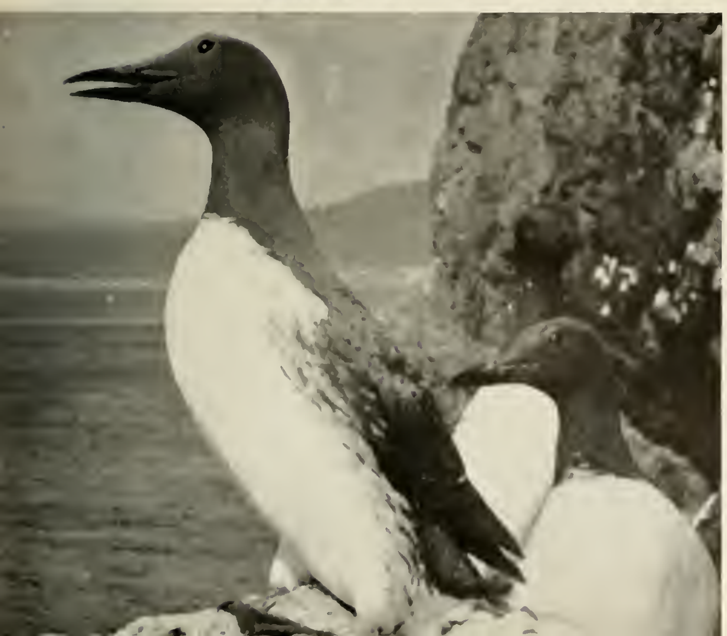
(Below) INCOMING MURRES travel full speed until within only 100 feet or less of the ledge. Then they set their wings and swoop upwards, back-pedaling only a few feet from the landing spot, and land as lightly as sparrows. A few were seen to misjudge their landing and tumble over and over among the rocks, but this may have been due to the photographer's presence

A VERTICAL BANK. Though not given to fancy flying, murres can execute sharp turns when frightened. This one came up to land but became frightened, banked sharply, and made a neat right angle turn



PROBABLY A NESTING PAIR. There is no way of identifying the sexes by outward appearance. Murres are highly social. Like this pair, they prefer to remain close to others of their kind, often in close contact





PORTRAIT OF A CALIFORNIA MURRE. This one shows dark feathers along the sides, probably a characteristic of not fully matured birds. Others which were assumed to have "come of age" were immaculately white clear up under the wing. At other times, waste oil from ships marred the clean beauty of their "starched shirtfronts." The matting of their feathers with oil is a man-made menace to these birds

Seven League Boots for Your Camera

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

THE naturalist's photographs of birds in their nests, of mother animals guarding their young, and of elusive mountain goats clinging to precipitous cliffs, all have a charm that wins ready recognition. Almost all photography of this type must have recourse to optical magnification so that the wildlife will appear as the dominant feature in the picture. Just as the naturalist uses field glasses to see his quarry better, so must the cameraman be equipped to magnify the image of distant game.

Long lenses

The development of special lenses to make distant objects larger so that they appear closer to the camera than they actually are is an interesting chapter in the history of photography. When optical design was young, cameras were fitted with lenses of long focal length to achieve this magnification. The Auto-Graflex camera was equipped with long bellows to take lenses of this sort. As in all Graflex cameras, the photographer had the advantage of looking down into the hood and focusing his subject on a ground glass screen right up to the moment of exposure. However, a lens with a focal length of ten or twelve inches and a diameter of two and one-half or three inches, projecting from the front of the body, gave the camera a good bit of weight and caused it to be front-heavy. In spite of this defect, a naturalist's Graflex was later made that would take even longer and heavier lenses; and, notwithstanding the bulk and ponderousness of these cameras and lenses, marvelous work was done with them by indefatigable workers.

Telephoto lenses

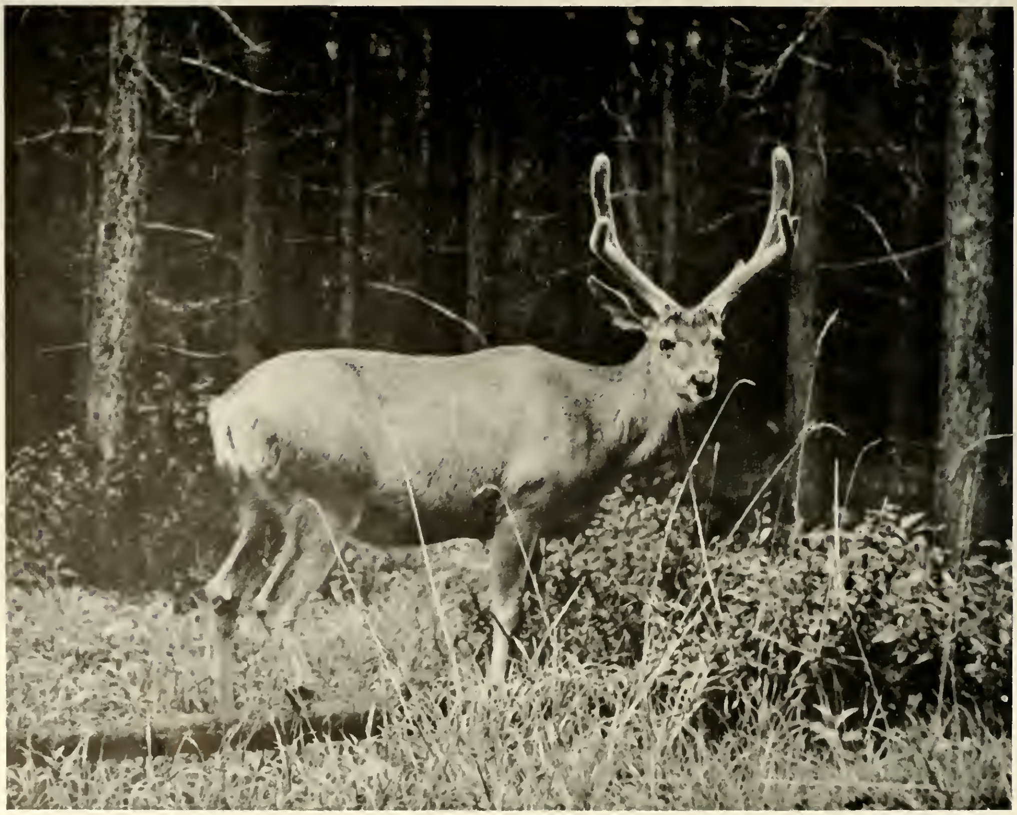
The cameraman's load was lightened considerably when the fast telephoto lens was designed. This lens has a second rear magnifying component built into it which increased the size of the image cast by the front lens. The whole unit was much smaller and lighter. For the same degree of telescopic effect, the lens did not have to be as long as formerly, and though the lens might properly be marked as a seventeen-inch lens, its actual length was somewhat less. This eliminated the need for a huge bellows extension.

Some of these lenses were built to have an adjustable magnification; but because of their lack of critical sharpness, they lost favor and few are seen today. The telephotos now in common use are the fixed magnification type. The sizes ordinarily used by Graflex owners are the eleven-inch or seventeen-inch, f:4.5 or f:5.6.

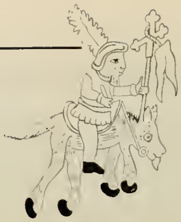
Continued on page 182

Mule deer in the velvet, Jasper National Park: photographed with an 11-inch telephoto lens at a distance of 100 feet. This reproduction is an enlargement from a small section of the negative

Charles H. Coles photo



HORSE GODS *of* Guatemala



From the *Codex Telleriano Remensis*

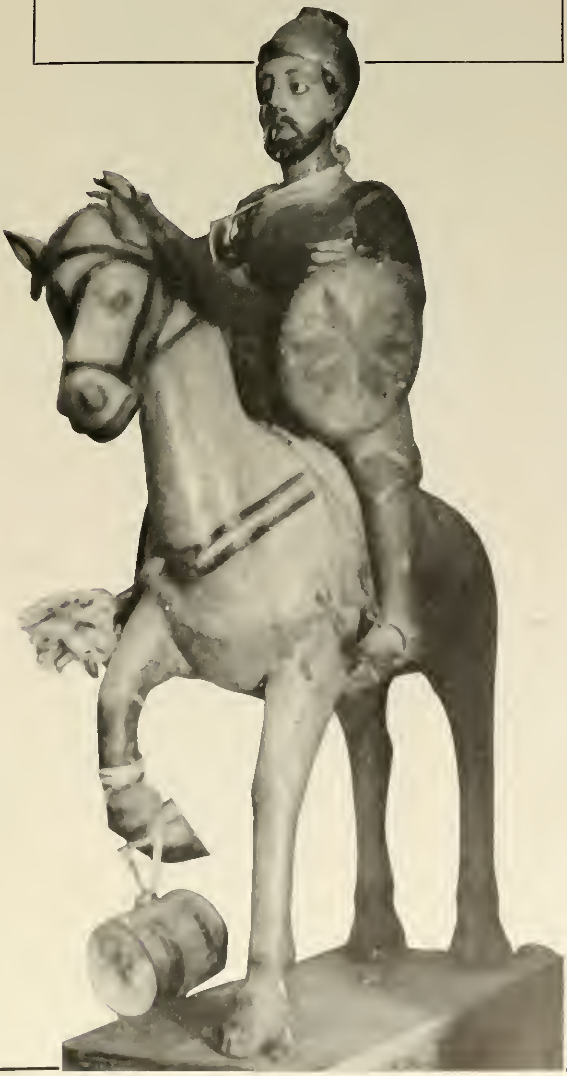
The Spanish conquistador on his mount, depicted above by an Indian artist of the time, became a symbol not only of worldly but also of supernatural authority

America's first invasion by men riding on horses was a terrifying event that has cast its shadows even into Indian religious practices of modern times

By Dorothy Reynolds

The first horses in America were those brought over by the Spanish *conquistadores.* And yet, when early Franciscan missionaries reached Lake Petén in the heart of the jungles of tropical Guatemala, they discovered an island upon which lived a tribe of Indians who worshipped the image of a white charger as the most sacred of all their idols. The animal, known as Tzimin-Chac, the Tapir God of Thunder and Lightning, was carved as if rearing up on its haunches, with the front legs straightened out to support its partly raised body. Upon seeing it, one of the Spanish priests, Friar Juan de Orbita, in a frenzy of religious zeal, broke it into a dozen pieces and scattered them over the floor of the temple. Thereupon, the Indians, very angry at the white men for coming into their land and demolishing their most sacred possession, set up a great cry of "Kill them! Kill them! They have destroyed our thunder god!" and rushed at the intruders with such fury that the Spaniards were barely able to get away alive, with the islanders at their heels, chasing them to the water's edge and pelting them with stones and arrows as long as the boat was within reach.

The story of how that horse became the idol of so isolated a tribe is a curious one. Shortly after Cortez completed the conquest of Mexico, he made a trip southward into Central America for the purpose of exploring that region and finding out whether or not it, too, was worth subjugating. While he was passing through the Petén district, his own horse, a fine white charger, became injured or exhausted, so he left it with the Indians, giving them strict orders to treat



A central figure in almost every church in Guatemala, the horse of Santiago is treated with scarcely less veneration than its rider and is only one of several symbolic horses reflecting the emotional impact of a distant event it well, as he would return for it later. The natives, who had never before seen such an animal, took his directions very seriously. So divine a creature, they thought, should be offered only the finest and most delicate of foods, and therefore they fed it nothing but cooked meat and fowls and bouquets of fragrant flowers. Naturally, the poor horse soon died of starvation, whereupon the terrified Indians made what amends they could by carving a stone image of it to set up in their temple.

Strange as it may seem to us, that idea was a natural one to the natives of Petén, for they were already accustomed to worshipping the tapir, which is still found in various parts of Central America. This animal is about the size of a donkey, and its nose ends in a sort of short trunk. Indeed, when archaeologists first found tapirs carved on ancient monuments in Central America—without knowing anything about the animal—they thought they were elephants and began an excited attempt to link up Maya civilization with that of the Far East.

As a deity the tapir was supposed to preside over storms and lightning.

The Indians at first thought that the deafening noise and deadly flash of the Spaniards' guns came from the horses rather than from the weapons carried by their riders. Hence they associated these new animals with their own "lightning beast." Even today the hand-woven shawls and blouses of the Indian women of the Guatemalan Highlands are frequently decorated with both tapirs and horses.

Though there is no record that the image of the horse god was set up again on the island in Lake Petén after its destruction by the Spaniards, various other horse deities still exist in Guatemala. The most popular masked dance of Guatemala is the dance of the Conquest, in which the villagers, mounted on horses, dramatize the coming of the Spaniards. Another horse that is sometimes deified is the mount of Santiago, patron saint of Spain and also of Guatemala. A statue of the mounted saint is a central figure in almost every church, and the horse is treated with scarcely less veneration than its rider. It is the patron of four-legged animals and is credited with many miracles in restoring horses and mules to health.

But perhaps the strangest ceremony is performed on Saint Thomas' Day at the village of Chichicastenango. At that time the little figure of a white horse carrying a rider dressed like a Spanish *conquistador* with a chain of old coins about his neck is first paraded round and round the town. Then one of the Indian men dances with him in his arms, after which a rope pulley is erected between the ground and the church spire. To this rope the horse and rider are fastened, and by means of it they are kept riding up and down, all day long and far into the night. At intervals, the little figure is removed from the pulley and the Indians pay five cents each for the privilege of dancing with him in their arms and giving him messages to take aloft. Sometimes fireworks are fastened to the horse and set off as he rises.

Various attempts have been made to explain the origin and significance of this curious *santo*, who is certainly not included in the calendar of Christian saints. The most probable theory is that he carries man's wishes up to the Sun God. Before the Spaniards came, the Mayas used a monkey for this purpose, but the horse could run more swiftly, so he was given the task. Very likely the little horse and rider are also connected with Alvarado, the conqueror of Guatemala, for he too came mounted on a horse carrying thunder and lightning in his gun. It is said that because of his extraordinary powers and his fiery red beard and hair, he was given the title Tonatiu, The Sun.

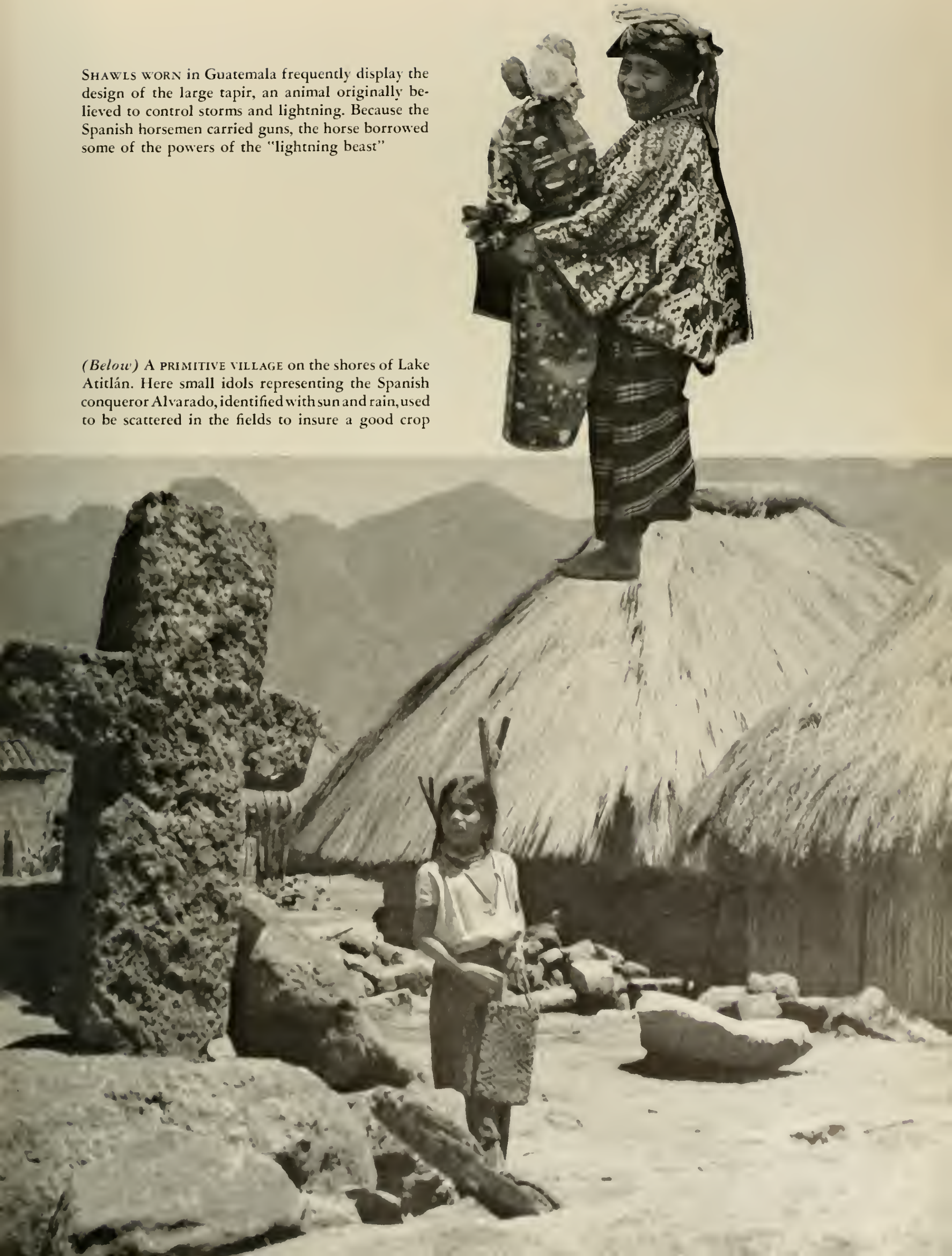
Inhabitants of the isolated village of San Pablo on the shores of Lake Atitlán showed me a small stone idol which they insisted represented Alvarado. One of them had picked it up in a cornfield, where figurines of this sort often used to be scattered broadcast to insure a bountiful harvest. It was a little head, about an inch and a half long, with distinctly Caucasian features and a headdress resembling the casques worn by Spanish soldiers at the time of the conquest.

Though such a deification seems strange at first thought, a man connected with both sun and rain might well be considered god-like, since these two elements are essential to the production of a good crop of corn.

When the Franciscan missionaries devoutly destroyed the image of Cortez' white charger, they did not realize that their violent effort to stamp out veneration of horse deities would have so little success. Centuries later the descendants of the same Indians who had worshipped the white horse still preserve in their superstitions traces of that long-past event which so terrified their ancestors—the invasion of their country by Spaniards mounted on horses and carrying death-dealing guns.

SHAWLS WORN in Guatemala frequently display the design of the large tapir, an animal originally believed to control storms and lightning. Because the Spanish horsemen carried guns, the horse borrowed some of the powers of the "lightning beast"

(Below) A PRIMITIVE VILLAGE on the shores of Lake Atitlán. Here small idols representing the Spanish conqueror Alvarado, identified with sun and rain, used to be scattered in the fields to insure a good crop



YOUR NEW BOOKS

WESTERN APACHE INDIANS • MYTH OF THE NEGRO PAST
THE JOHNSONS AT PARADISE • JOHN STEINBECK • BALI
THE PIGEON • CACTI • WEATHER AND AVIATION • TREES

THE MYTH OF THE NEGRO PAST

- - - - by Melville J. Herskovits

Harper, $4.00

IN this volume Doctor Herskovits analyses a vast amount of material, from which he concludes that the present-day North American Negro is motivated in many ways by survivals from his West African homeland, that he has an actual African traditional past. To the mind of this reviewer, however, the Negro of the United States has lost practically all of his West African heritage, and the evidence which Doctor Herskovits brings to the contrary is not, on the whole, convincing.

According to my experience, the purest African culture patterns of the present-day Western Hemisphere are to be found among the Dutch Guiana Bush Negroes (to whom I had the privilege of introducing Doctor Herskovits on an expedition in 1928) and to a lesser extent among the Haitians, the Negroes of Cuba, Martinique, and Guadeloupe. Aside from the Bush Negroes of Dutch Guiana, whose history is unique, African survivals appear to be most pronounced in the Latin countries of this hemisphere and least pronounced in those dominated by Anglo-Saxons. For this reason, Louisiana, where French and Spanish traditions still remain, is the last locality where one can point with any degree of certainty to African survivals here.

I cannot agree that spirituals and jazz resemble aboriginal African music, or that secret fraternal societies are necessarily of African derivation as their counterparts are to be found among the whites and Indians. Belief in spirits and to some extent witchcraft does survive, but so does it among certain white people where contact with the Negro has been at a minimum. But, unquestionably, spiritual practice with West African flavor is to be found in parts of Louisiana even at the present time. The maternal family system which Doctor Herskovits points to as further proof of African survival is open to question because economic competition in the South and elsewhere discriminates against male Negro labor, and makes it easier for the mother, as a domestic servant, to be the breadwinner.

Although I cannot agree that Doctor Herskovits has proved his hypothesis, *The Myth of the Negro Past* is full of carefully collected information which the professional anthropologist will find most interesting and useful.

In areas devoid of racial persecution, like the jungles of Dutch Guiana, the Negro is a dignified and often highly skilled individual having a natural aptitude for arts and crafts. He could certainly serve a more useful purpose in this country than he is permitted to at the present time.

MORTON C. KAHN.

THE PIGEON

- - - - by Wendell Mitchell Levi

R. L. Bryan, Columbia, S. C., $10.00

WE feel that the introduction of this book to the readers of NATURAL HISTORY Magazine should be preceded by a call to attention! For NATURAL HISTORY does not often have the privilege of calling the attention of its clientele to so notable a publication. Listen, therefore, while Mr. Levi tells us of the pigeon as friend, ally and co-laborer, companion in sport, source of occupation, laboratory assistant, and means of support.

The Most Amazing Story in the World!

HOW MAN BECAME A GIANT

By M. Ilin & E. Segal

How did man—of all the animal kingdom—discover the two things that lifted him above the others: how to use tools and how to speak and write? This book tells the whole exciting story for young people. Dr. A. Hrdlicka of the *Smithsonian Institution* calls it, "The best book in this line." Dr. H. L. Shapiro of the *American Museum of Natural History* recommends it as, "Beautifully organized, skillful . . . veracious." 42 illustrations. $2.00

150 years of publishing

J. B. LIPPINCOTT COMPANY
East Washington Square, Philadelphia

Darwin's belief that the rock pigeon (*Columba livia*) is the ancestor of the domestic pigeon and its many breeds and varieties is still the prevailing opinion. Doubtless no other bird combines so large a measure of freedom with a corresponding degree of domesticity. Migration, mating, nesting, behavior, variation, and inheritance can, therefore, be studied more effectively with the pigeon than with any other bird. As pigeons are so closely associated with man, Mr. Levi very properly opens his subject with an attractive chapter on the relationship of pigeon and man (pp. 1-15). The pigeon's part in art, religion, and literature; the history of war heroes; the companionship of pigeons are presented here. Then we at once plunge into a study of breeds and varieties (pp. 16-153). These 137 pages treat of the very heart of practical pigeon lore. They are illustrated by 340 photographs, most of them from living individuals. Accompanied by a statement of date and place, they obviously are invaluable to the pigeon breeder.

"Anatomy" (pp. 154-173), "Physiology" (pp. 174-207), "Genetics—Variation and Inheritance" (pp. 208-251), "Behavior" (pp. 264-275), and "Practical Breeding" (pp. 250-263) all contain material of scientific interest and are particularly important for the ornithologist.

In "Diseases—and their Control" (pp. 279-333), "Feeds and Feeding" (pp. 334-384), "Commercial Squab Production" and "The Pigeon Fancy" (pp. 416-440) we again return to the wants of the pigeon raiser.

The book is well-made, and the numbering of the 1190 paragraphs greatly facilitates reference. We wish that the illustrations were also numbered. Finally, we say, own this book or at least read it.

F. M. CHAPMAN.

SEA OF CORTEZ

- - - - - - by John Steinbeck and
Edward F. Ricketts

Viking, $5.00

THIS remarkable book is an account of a remarkable expedition to a remarkable region, the Gulf of Lower California, called by the writers by the more historic and picturesque name, "The Sea of Cortez."

The book is remarkable because it includes two contrasting presentations of the same theme. The first half of the book embodies a vivid narrative of the voyage and expeditionary work, by a famous novelist.

The second half is a scientific account of the important results of the voyage.

Each author, being expert in his line, presents his theme in masterly fashion from his particular viewpoint. Yet it soon becomes evident to the reader that the novelist and philosopher is also a naturalist at heart, while the scientist betrays keen philosophic and vivid descriptive powers. The fact that a novelist and zoologist could go on a voyage together in a small boat and work with sympathetic understanding is a demonstration of their essential community of thought and mutual intellectual respect.

In the first half of this volume, John Steinbeck pictures skillfully the casual events and exciting moments of the voyage. He takes part in the collecting and portrays the habits of the marine shore fauna with keen observation and colorful characterization, interpolated with philosophic comments.

In the second half of the book, under the prosaic title of "Phyletic Catalogue," Edward F. Ricketts describes in detail the greater part of the 550 species, mostly invertebrates, collected by the expedition. He states that possibly ten per cent of these may be new to science. This feature of the work is so well arranged and so clear in the presentation of a little-known littoral fauna, that it is bound to be of inestimable value to all marine zoologists. The valuable summary, presented in his Introduction, contains important information of ecological factors of this isolated biological region, while the series of color plates, drawings, and photographs is splendidly reproduced and forms a valuable adjunct to the use of the volume by students of West Coast invertebrates.

ROY WALDO MINER.

THE SOCIAL ORGANIZATION OF THE WESTERN APACHE

by Grenville Goodwin

University of Chicago Press, $4.50

THIS book on the Western Apache is not merely one of the best accounts of an Indian tribe; it is unfortunately the last work of a young man of unusual talents. Grenville Goodwin began the study of the Apache when about 23 years of age and at his death ten years later left not only the manuscript for this book but notes planning several additional volumes. The reader who wishes to know the plain facts of Indian life will be the richer intellectually for having read this book. For example:

"Formerly, the greatest achievement in life that a woman could hope for was to marry a good man, have children, excel in woman's work, be wealthy through her own efforts and those of her husband, have good sons-in-law, and sometimes possess and practice minor ceremonies. The two highest attainments for a man were to become a powerful and influential shaman or a great hunter, warrior, and leader. These two aims were seldom reached by a single individual, as the first called for imagination, a certain mystic quality, and ability to lead and influence people spiritually, and the second required an innate gift for leadership and an ability to excel in hunting, raiding, war, and speechmaking.

"Modern objectives in life have not changed as much for women as they have for men. The young man now idealizes the cowboy and sometimes the shaman, and the day may come when he will wish to be a member of the elected council of his people."

The author's insights, spread over the pages of the book, were secured by mastering Apache speech and spending long periods of time with his Indian friends. Yet this is not a sentimental book, just a clearly-written, factual account.

CLARK WISSLER.

FOUR YEARS IN PARADISE

by Osa Johnson

Lippincott, $3.50

FOUR short years taken from the adventurous life of Mr. and Mrs. Martin Johnson make up the tale of this book. They were four very full years and tell of a dream come true.

On a previous trip into northern Kenya Colony, the Johnsons had been introduced to a lake with most picturesque surroundings, far removed from the routes of the big game hunters. In this place the animals had roamed unmolested, were numerous and exceedingly tame. The Johnsons named the spot "Lake Paradise" and resolved to return at a future time for the purpose of taking pictures of these animals in their native haunts. They wished to bring back to civilization a record of the habits of the big game while it was still possible, before the intrusion of white man forced the creatures to change their mode of life. Back in America they interested influential persons and a most elaborate equipment was assembled.

Returning to Africa the Johnsons immediately proceeded to Lake Paradise and there built a home for themselves. Interesting parts of the book tell how they changed their little section of the wilderness into most comfortable abode, not only in building a house for living quarters but also extensive laboratories for the developing of their films, an electric plant, workshops, storehouses, and flower and vegetable gardens.

Using Lake Paradise for a base, the Johnsons made many safaris onto the neighboring plains, following the game as it made its migrations during the rainy season.

That their enterprise was a tremendous success may be vouched for by the many thousands of persons who have witnessed the remarkable films that were brought back. The public is most fortunate in that the Johnsons were not only outstanding photographers but that they were also capable of writing of their experience in such an enjoyable and entertaining way. The book is both interesting and readable and can be recommended not only to a person interested in natural history but to anyone who enjoys easy, entertaining reading. As might be expected, the book is profusely illustrated with some of the Johnsons' best pictures.

T. DONALD CARTER.

Continued on page 184

"May th' hielands aye breed guid whisky an' guid men!"
"It's the flavour"
TEACHER'S HIGHLAND CREAM
Perfection of Blended Scotch Whisky
Wm. Teacher & Sons
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SEVEN LEAGUE BOOTS FOR YOUR CAMERA *Continued from page 176*

Size of image

Actually, with a camera taking, let us say, a 4 x 5 film or plate, an eleven-inch lens gives an image that is less than twice the size secured with a standard lens of, say, seven inches. Even a seventeen-inch lens gives less than three times magnification. To determine what a given telephoto lens will accomplish for you, simply compare its rating in inches with the focal length of the ordinary lens. If your camera is equipped with a seven-inch lens, for example, an eleven-inch telephoto will give you an image eleven-sevenths the ordinary size, or almost 60 per cent greater. A seventeen-inch telephoto will increase the size by 140 per cent.

Further saving of weight

If we examine the negative made by a naturalist-photographer using a telephoto lens on a large camera such as we have been describing, the image of a wary animal will occupy only a tiny area—perhaps an inch square, or even less.

Why carry around such a bulky camera? By using a small camera loaded with 35 mm. film, the photographer can eliminate needless drudgery. This leads to the use of the miniature camera equipped with a telephoto lens. The size of the image on the negative remains the same. No detail is lost. The only precaution is to make sure that the tiny image falls on the tiny film. An accurate finder solves this problem.

Color to the rescue

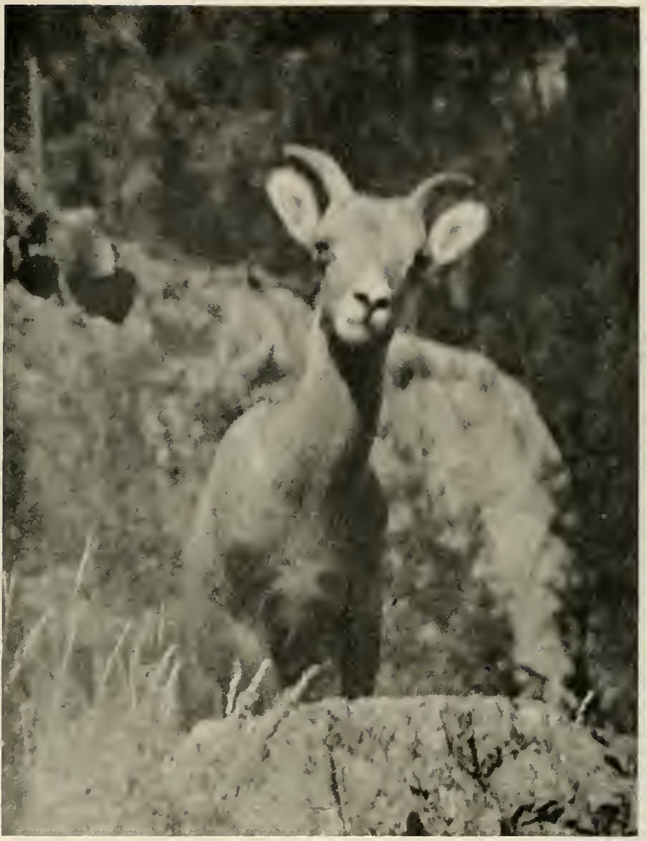
Now the system can be carried even further. If we find a film with exceedingly fine grain, we can use a smaller film and in consequence be even farther away from the animal and still fill the whole picture area. The fine-grain film is yours for the asking: it's name is Kodachrome. Practically grainless in structure, Kodachrome makes possible the recording of exceedingly fine detail. The smaller film is of course the 16 mm. motion-picture film. Here is how the system works out:

A motion-picture camera is adapted to take an eleven-inch telephoto lens. Between the lens of the film, some form of reflex focusing is introduced, so that the image cast by the lens may be studied and focused on a ground glass. The image on the ground glass is examined with a magnifying eyepiece to adjust the focus perfectly. The ground glass also shows the field that will be included, so that the subject can be accurately placed in the picture. When these adjustments have been made, the focusing reflex device is withdrawn and the scene is filmed.

The lens, because of its length, requires a special support. Without this it might "droop" enough to pull out of line. The camera must be set on a sturdy tripod to avoid even the slightest vibration, which might spoil the picture.

The advantage of the motion-picture camera in this type of work, besides the tiny film it uses, is that you may choose from many exposures in the strip of film and use the one which best suits your purpose or fancy.

Continued on page 183



Charles H. Coles photo

Enlarged six times, this photograph of a rocky mountain ewe is the reward for the cameraman who is equipped with an 11-inch telephoto lens, and $3\frac{1}{4} \times 4\frac{1}{4}$ film

---

THE COVER THIS MONTH

March
NATURAL HISTORY
1942
FIFTY CENTS

The picture on the cover of this issue is a most unusual photograph of a difficult subject, the ruffed grouse in courtship display. It is the work of Mr. Cleveland P. Grant who is to be commended for his patience in securing such an interesting picture.

The courtship display, with the tail and the neck-tufts spread fanwise, is exhibited by the males, probably only in the presence of the females as was the case when this photograph was taken, when it may follow a drumming performance. During the display, the male shakes his head from side to side with such vigor that the rush of air through the neck feathers is audible nine feet away.

In the drumming performance, the male stands more erect and drops his tail to help brace himself on the log. He then snaps the wings rapidly forward and upward, first in three or four single beats, then in a crescendo of faster strokes, ending in a whirring roll in which the moving wings appear only as a blur. The sound thus produced is not made by the wings beating against each other, as was once believed, but by the percussion against the air and perhaps the vibration of the wing-quills.

The ruffed grouse is known locally by different names among which that of "partridge" in the north and "pheasant" in the south are most familiar. Actually it is neither.

SEVEN LEAGUE BOOTS FOR YOUR CAMERA

Continued from page 182

One step more

At the American Museum we have carried the operation one step further. The 16 mm. transparency has been enlarged by photographing it with a Leica equipped with extension tubes. By photographing it on Kodachrome, the color of the original was preserved, and a magnification of three and one-half times was achieved to make the 16 mm. frame fill a 35 mm. slide. The result, while not critically sharp, was pleasing and natural in appearance, and the final size of the image was the same as if a 40-inch telephoto lens had been used on a miniature camera! That is a rare magnification even for modern photography.

LETTERS

Continued from page 131

SIRS:

. . . It is one of the most interesting publications that comes to my desk.

The President of a large
life insurance company.

* * *

SIRS:

. . . Your magazine covers certainly mark an epoch in publishing, and the birds and animals,—especially those which the rank-and-file thousands of us can never see, either alive or stuffed,—appeal both to the artist and the student and lover of animal life.

The little "Woods Pussy" [November cover] is doubtless familiar to many of us, but the combination of patience, good luck, and high artistry are an inspiration to any animal photographer. . . .

NELLIE B. PENDERGAST.
Duluth, Minn.

* * *

SIRS:

I enclose $3.00 in money-order remittance for the renewal of my subscription, which is due shortly.

After one year, I find that the Magazine is quite as interesting and as well done as when I began. . . . What I wish to say is that the covers are still superb examples of the photographic art, in color relation and in composition, the contents are as varied and as well illustrated as ever, and the criticisms are as impartial as before. I now look forward to your magazine in a new sense, that of a reminder that there are still some who work for the advancement of the sciences and the arts. It is a stabilizing force in these times.

DELMAR NORDQUIST.
Mattoon, Ill.

LETTERS

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 184

1. It melts only at high temperatures; it reacts neither to acids nor bases; and you can't open your eyes on a city street without seeing it. What is it?

2. In which of the following U. S. Army equipment is chromium used?

(a) Uniforms
(b) Rifle stocks
(c) Hobnails

3. Niagara Falls will get higher before it gets lower.

True........ False........

4. When Japan overran the Philippines, we lost ¾, ½, or ¼ of our chromium imports?

5. What insect once provided the paper on which a book was printed?

6. If you perished in the northwestern wilderness, wolves would devour your body.

True........ False........

7. The Canadian Fall of Niagara will someday capture all the water of the American Fall, leaving it a dry monument to its former glory.

True........ False. .. ...

8. North American timber wolves attack man.

True... . .. False........

9. The wild mammal most frequently mentioned in the Bible is the

(a) Hare
(b) Lion
(c) Wolf

10. Chromium's chief virtue in steel alloys is to make them

(a) Harder
(b) Softer
(c) Chemically resistant

Natural History
ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration Nile River Group Detail showing Antelope Akeley African Hall American Museum of Natural History

Continued from page 181

BALI

- - - - - - by Philip Hanson Hiss

Duell, Sloan & Pearce, $4.50

THERE are many different Balis: the Bali which a Dutch administrator sees, the Bali which a Balinese peasant or a Balinese prince sees, the Bali the interested American tourist sees and also hears about—from other European residents in Bali. Mr. Hiss's book is a compact statement of this last Bali, the stereotype which has been built up by successive publications, the most complete of which is Covarrubias' *Island of Bali*. The letterpress statements are about the communalistic life of the Balinese, about the historical relations with Java and Hindu civilization, the organization of Balinese village life gleaned from the stock in trade of the white residents of Bali, passed generously from resident to visitor and back to new white residents. Most of these statements have now become the standard things that traveled persons know about the Balinese, and they form an appropriate background for a series of very good photographs of the types and activities which everyone who has or has not been to Bali expects to see.

The whole book, coming as it does on the heels of so many books, so many articles, so many moving pictures and still pictures of Bali, has all the charm of the familiar well done. Even those who have been to Bali will recognize, if not the actual personnel of the photographs, at least the subjects, because they will have seen old men and young girls, just exactly like them, in other photographs. They will be delighted that the photographs are so very good and flattered by their response to the familiar, and they will enjoy the book. People who have been to Bali, whether for three days or three months, will enjoy recognizing the scenes and guessing at details of identification not given—which is no reproach to Mr. Hiss, who has been most systematic and careful in identifying each photograph.

MARGARET MEAD.

TREES OF THE EASTERN UNITED STATES AND CANADA

- - - - - by William M. Harlow

Whittlesey House, $2.75

DOCTOR HARLOW, who is Assistant Professor of Wood Technology in the New York State College of Forestry, has planned this as a field book, and it is just that—a compact manual for the pocket. It contains nontechnical keys for the identification of the native and also the most common introduced trees of the area treated. The book is illustrated with numerous excellent and helpful photographs, more than a dozen of which are in natural color. Unfortunately two of the latter, facing page 130, are upside down.

Each tree is described with reference to general appearance, leaves, flowers, fruit, twigs, bark, habitat, distribution, and remarks. Under remarks the author has included considerable woodcraft and folklore of the various trees.

The making of single words of such names as honeylocust, hophornbeam, osage-orange, waferash, and mountainash bothers this reviewer, because it is not common practice and does not agree with Webster's *Dictionary*. Such words are usually compounds or they are divided into two words. The author himself is not consistent—note that "yellow-wood" is compound on page 32, and one word on page 223; "water beech" is two words on page 132, while "honeylocust" is one word, page 214.

Nevertheless, the book is a very attractive and most useful one.

CLYDE FISHER.

WHAT KINDA CACTUS IZZAT?

- - - - by Reginald W. Manning

J. J. Augustin, $1.25

WHEN I first saw this little book, I was prejudiced against it by the Milt Gross title. But after I dipped into it, I was intrigued by the clever drawings and appropriate text. In short, I was unable to lay it aside until I had finished it. The author's satiric references to Latin scientific names reminds one of Edward Lear's *Nonsense Botany*, with the difference that the former's effect is gained by use of real scientific names. The drawings remind one of those of Dr. R. W. Wood in his *How to Tell the Birds from the Flowers*.

In spite of his mischievous jabs at the botanists, the author himself is a good, dependable botanist. His only entomological statement, however, is open to grave doubt. He says: "Each of the 30 varieties of Yucca has its own particular moth which (with perhaps one or two exceptions) will have nothing to do with any other species of Yucca." As far as I have been able to learn, there is only one species of yucca moth, namely *Pronuba yuccasella*.

Altogether it is a most entertaining little volume, especially for those who have been in the cactus belt.

CLYDE FISHER.

Answer to Questions on page 183

1. Chromium. See page 149
2. (a) Chromium is used in the dyes of olive drab uniforms. See page 148
3. True. Niagara will get higher as it recedes upstream. Eventually it will reach softer rocks and become a series of cascades. See page 160
4. We lost ¼ of our chromium imports when Japan overran the Philippines. See pages 149, 155
5. A wasp provided the paper on which an eighteenth century book was printed. See page 152
6. False. The bodies of men who have died in the wilderness of the Northwest remain undisturbed by wolves. See page 140
7. True. The American Fall of Niagara will go dry when the Canadian Fall recedes beyond the head of Goat Island. See page 160
8. False. Though the North American timber wolf in a trap will fight and bite a man, there appear to be no authentic cases of its attacking a person. See page 140
9. (b) The lion is the wild mammal most frequently mentioned in the Bible. See page 155
10. (c) To make them chemically resistant. See page 148

INDIAN PLACE-NAMES OF THE PENOBSCOT VALLEY AND THE MAINE COAST

- - - - by Fannie Hardy Eckstorm

University of Maine, Paper-bound, $1.50

AN English geographer once said that the United States possessed a unique series of geographical names, superior in sound and symbolism to those of any other country. He had in mind names derived from Indian languages like Ohio, Penobscot, Connecticut. For the eastern states where such names abound, handbooks have been compiled giving the origin and original meaning of such names. This volume is a worthy addition to the list and is recommended to our readers. The author spent her leisure time for years identifying the tribe from which the name came and then securing from the surviving tribe members the correct form of the original and its meaning. Interesting notes are given with each name, alphabetically arranged. Curiously enough, most of the names on the coast of Maine are identified as Micmac, whereas the traditional and historic home of that tribe was in Nova Scotia. For this the author has no satisfactory answer, except that they were familiar with the coast and guided the first settlers to the several localities.

C. W.

CLOUDS, AIR AND WIND

- - - - - - - - - - - by Eric Sloane

Devin-Adair, $2.50

THIS is a most timely and welcome book in these days of an air-minded world. In simplified language and with cartoon illustration, it explains the essential principles of meteorology. The text is short and yet entirely adequate and the cartoons are simple and well-done. They often have a distinctly humorous touch which, however, always serves to emphasize the principle being explained. The author is an artist of note, and also is a licensed pilot. As a result he has given much attention to those aspects of the weather and the atmosphere involved in aviation. Icing, fog, ceiling, visibility, and other factors are discussed and clearly diagramed in cartoon. Furthermore, there are fifteen excellent pictures of cloud forms, each of which also contains a "portrait" of some modern type of plane.

If you are an amateur who wishes to learn much about the factors involved in the daily kaleidoscopic story of the sky and the weather; or if you are interested, or have a son who is interested, in aviation, this book is to be recommended for your careful attention.

H. E. VOKES

April

NATURAL HISTORY

1942

orth America in New York · Everglades Tribe · Masks

trategic Manganese · Heraldic Leo · G. G. Simpson

UME XLIX, No. 4

FIFTY CENTS

Good Neighbor Policy

March
NATURAL HISTORY

Introduce NATURAL HISTORY Magazine
to your friends!!

Send request for literature to the Membership Secretary

The American Museum of Natural History, 79th Street at Central Park West, New York, N. Y.

LETTERS

SIRS:

In your February issue of NATURAL HISTORY I read of strange snow formations found at the bottom of a hill near Schenectady, New York. A few days ago my sister and I noticed the same strange formations. Enclosed are two pictures of them. These "rolls" were at the bottom of a steep hill, but farther up we could see small "flaps" of snow just beginning to curl. My analysis of this is that the snow must be crusty and melting, the crust, becoming heavy, begins to curl and rolls down the hill.

I might add that I enjoy your magazine and read each issue with great interest!

MILDRED DICKEMAN.
(age 12)

Salt Lake City, Utah.

* * *

SIRS:

I believe that a fairly simple explanation will account for the beautifully photographed rings of snow, published on page 67 of your issue for February. In a word, I think the answer to the puzzle is *evaporation.* We all realize that when a heavy gob of snow falls from the limb of a tree and lands on a steep slope of sticky snow, it rolls downhill in such a way as to make a cylinder that is not only several inches to a foot in diameter but also many times thicker at the rim than in the center. On a warm day, the melting of the cylinder, especially if standing erect, would quickly cause the structure to collapse; but in a temperature below freezing the inevitable evaporation of snow particles would eat away the thinner center of the disk long before the rim showed any marked reduction in size or shape.

WOLCOTT CUTLER.

Charlestown, Mass.

* * *

SIRS:

Mr. Featherstonhaugh's pictures of snow-rings in your February number have proved too suggestive of my own youthful exploits and those of my classmates in Switzerland for me to resist clearing up the mystery.

If the snow is "wet" and has a certain consistency, anybody can produce what may develop into rings like those shown. Make a snowball that is cylindrical instead of spherical and start it rolling down a steep slope. If the snow is just right, it will gather more and more snow as it rolls, so that it may be 30 or 40 inches in diameter when it reaches the bottom. Both pictures show quite clearly where the descending roll gathered up the snow.

At the beginning of the roll, the snow will gather loosely; then as the weight increases, the outer layers will be more and more tightly packed. The result is that, when the temperature grows warmer, the loose middle of the cylinder will melt much more easily than the tightly packed outside, and when conditions are particularly favorable during the melting process, a time will come when only a ring remains.

In the Alps, where open slopes are several hundred or even a thousand feet long, I have seen snow that was overhanging from a *crête* fall down, divide into lumps from the impact on the slope below and there create *natural* rolls in quantity, developing into the comparatively rare "powder" avalanches (as distinct from the ordinary ones occasioned by whole layers of snow slipping downward). Such rolls vary from the size of a fist to balls ten to twelve feet in diameter.

R. FARMER.

New York, N. Y.

* * *

SIRS:

I have learned a lot about snow-rings since the pictures I took were published in NATURAL HISTORY Magazine. In all, I had 22 replies to the letter . . .

Continued on page 188

Natural History

ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

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Above illustration: Nile River Group—Detail showing Antelope
Akeley African Hall, American Museum of Natural History

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It's reassuring these days to see those sturdy Bell System trucks along the highway.

They are mechanized motor units. Each has a highly skilled crew; each has its own tools, power and materials. They are ready and efficient and can be mobilized anywhere, any time. And there are more than 27,000 of them.

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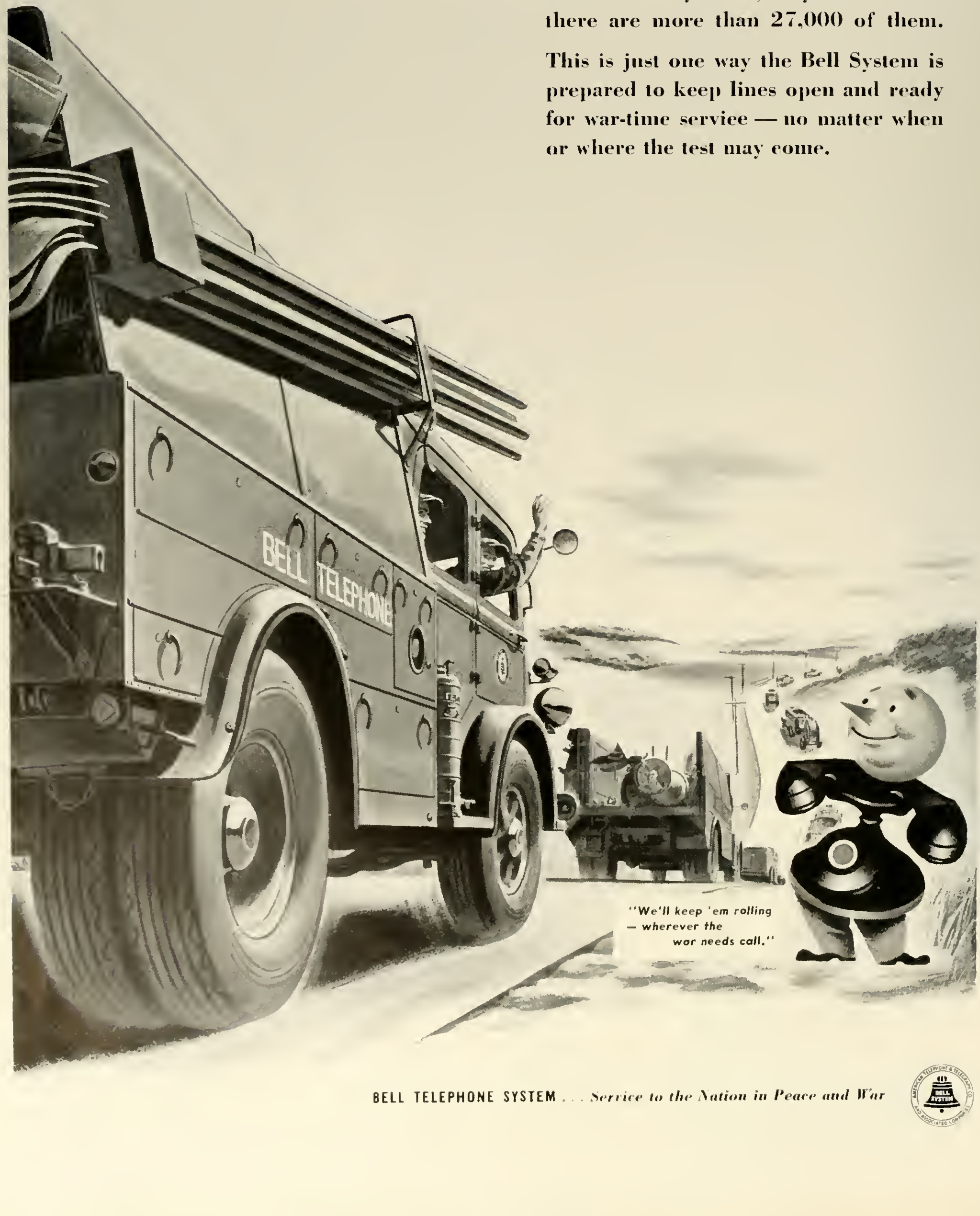
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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President
WAYNE MOODY FAUNCE, Acting Director

VOLUME XLIX—No. 4 ★ ★ ★ ★ ★ ★ **APRIL, 1942**

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Detail of an exhibit in the new North American Hall
From a Kodachrome by Thane Bierwert

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EDITOR: Edward M. Weyer, Jr., Ph.D.

ART AND PRODUCTION: Frederick L. Hahn.

ASSOCIATE EDITOR: D. R. Barton, A.B

ASSISTANT EDITOR: Ruth Gannett, B.S.

EDITORIAL ASSISTANT: Katharine Lahee, M.A.

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Continued from page 185

Most of the letters were from persons who had seen snow-rings. Several were accompanied by photographs of them. All but four of the writers suggested that the rings are formed when a curved bit of crust breaks from the top of an overhanging slope and rolls hoop-like down the grade, the wet snow filling in the curve on the open side.

Mr. Farmer's theory about the center of the snowball melting first sounds equally logical . . . I did not mention in my original letter that the snowballs, or rather snow-rings, in question could not have been formed by children. I found them in a remote section of the Helderberg Mountains, more than twelve miles from the nearest road. There were the tracks of one or two skiers through the section and a few footprints around the rings where the skiers apparently had taken off their skis to examine or photograph the phenomenon. There were no footprints leading up the bank or at its top.

These natural rings apparently are found in great numbers in the northern Adirondacks. Some of the persons answering my letter told of having seen as many as 50 or 60 in a single day. It is indicated that the rings sometimes are from three to five feet in height.

Duane Featherstonhaugh.

Schenectady, N. Y.

P.S. A few minutes after writing the above I chanced to talk to a General Electric Company scientist who says he doubts Mr. Farmer's theory. He grants that certain meteorological conditions may melt the center of a natural snowball, but points out that in this event the hole in the center would not be a perfect circle, a feature that is common to all rings.

And thus the matter stands.—Ed.

* * *

Sirs:

I was much interested in two of the articles in the February Natural History. May I felicitate you especially on that by Doctor Gudger? Such articles as this are splendid, inasmuch as they present sound and scientific knowledge in a form that is easily assimilated by the layman, and which cannot help but encourage interest in such matters.

I also wish to compliment you on the series of which "The Meek Inherit the Earth" is the February article. My son, almost six, after prolonged study of the chart accompanying "Grandfather Fish," explained to me that the fish was undoubtedly responsible for the airplane included in the chart, for, as the fish was responsible for man's presence, so it must be held accountable for this product of man's ingenuity.

In Dobie's article, he makes the statement that "the coyote is not strong enough to move a carcass in the manner of the mountain lion [presumably by carrying], and so if he moves it at all, he must use his wits."

I have personally seen a coyote carry a four-months-old lamb in his mouth at a lope, until, hard pressed by a man on a running horse, the lamb was dropped as the little wolf jumped a four-foot woven-wire fence. That this was not unusual is indicated by the fact that over 30 lambs went the way of the one just mentioned. When the den containing the young coyotes was located, it was found to be approximately a mile from the pasture where the sheep were kept.

J. L. Baughman.

Houston, Tex.

* * *

Sirs:

I will always be thankful to the friend who first invited me to join the American Museum. I treasure every copy, but I do not hoard them. My pupils at school just about wear them out . . .

I hope the world situation will not make it necessary to change your publication.

Anne Bohlen.

Norfolk, Nebr.

* * *

Sirs:

I am enclosing a check for $3.00 for renewal of my subscription to Natural History Magazine for another year.

I am indeed pleased with it, having taught school for 50 years, and now at the age of 82 I find many interesting things in it. If I were able I would like to visit the Museum.

A. R. Cecil.

Spokane, Wash.

* * *

Sirs:

I subscribed to your beautiful (and satisfying!) magazine—Natural History—last fall. . . .

I have not yet forgotten the wonderful day I spent in the Museum in New York—and that was 12 years ago—and hope I will again be able to visit it in the not too distant future.

(Mrs. Peter) Grace Charlton.

Toronto, Canada.

* * *

Sirs:

Your Natural History Magazine is being sent to me as a gift from our local paleontologist, Mr. W. H. Peck, and I prize it very highly.

I particularly enjoy the biographies about various members and staff assistants of your American Museum of Natural History.

Each month I am looking forward to your magazine — and the biographies. Keep them coming.

Ruth M. Quam.

Ekalaka, Mont.

* * *

Sirs:

Last year in each issue of Natural History there was an article by D. R. Barton on the life and achievements of a member of the Museum Staff. These were exceedingly interesting and fascinating, and since I noticed that these articles were discontinued in the January and February issues, I wanted to know for what reason you have decided to drop them. These articles were so interesting that I shall appreciate it if you will write and tell me.

Being an inveterate naturalist I deeply enjoy to the fullest extent your magazine Natural History and think that it is without doubt the most beautiful and fascinating nature magazine in the United States.

Joseph L. Parkhurst, Jr.

Rahway, N. J.

Partly for the sake of variety and partly because a great many personalities have been presented in this way, the biographical articles have been temporarily suspended; but it is hoped that the series may be resumed in measure with the demand.—Ed.

* * *

Sirs:

This is to tell you how much I enjoyed Doctor Gudger's article on the least fishes [November, 1941]. I have read his things for years and must say they are becoming more suitable for a layman like me to enjoy. Of course, I could understand the early ones, but they were too technical for entertainment.

The make-up seems better, too. I don't know the technical terms, but I like the print, paper quality, spacing, etc.

Hope you will print more of Doctor Gudger's things if he continues his popular style.

Mrs. George Taylor.

Mooresville, N. C.

DO NOT MISS

THE ITINERANT EEL, by Paul Bulla. Greeks named Jupiter their father. The canny Aristotle designated earthworms. Pliny pronounced them sexless. And centuries passed before mankind began to find an explanation for the baffling mystery. Now we know that newborn generations of this most extraordinary fish swim to their homeland after their parents have journeyed 2500 miles to give them birth far out in the mysterious Sargasso Sea, deep beneath the weed-clogged surface. How do they do it?

Plus the usual variety of short subjects, including **OUR CLEOPATRA,** by Mr. and Mrs. Edwin C. Weidlich, a word and camera chronicle of the odd life of an Egyptian tortoise in a modern American home.

NOTICE Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

THE
NEW HALL
OF
NORTH AMERICAN
MAMMALS
BRINGS
THE WILDLIFE
OF OUR CONTINENT
TO
NEW YORK CITY

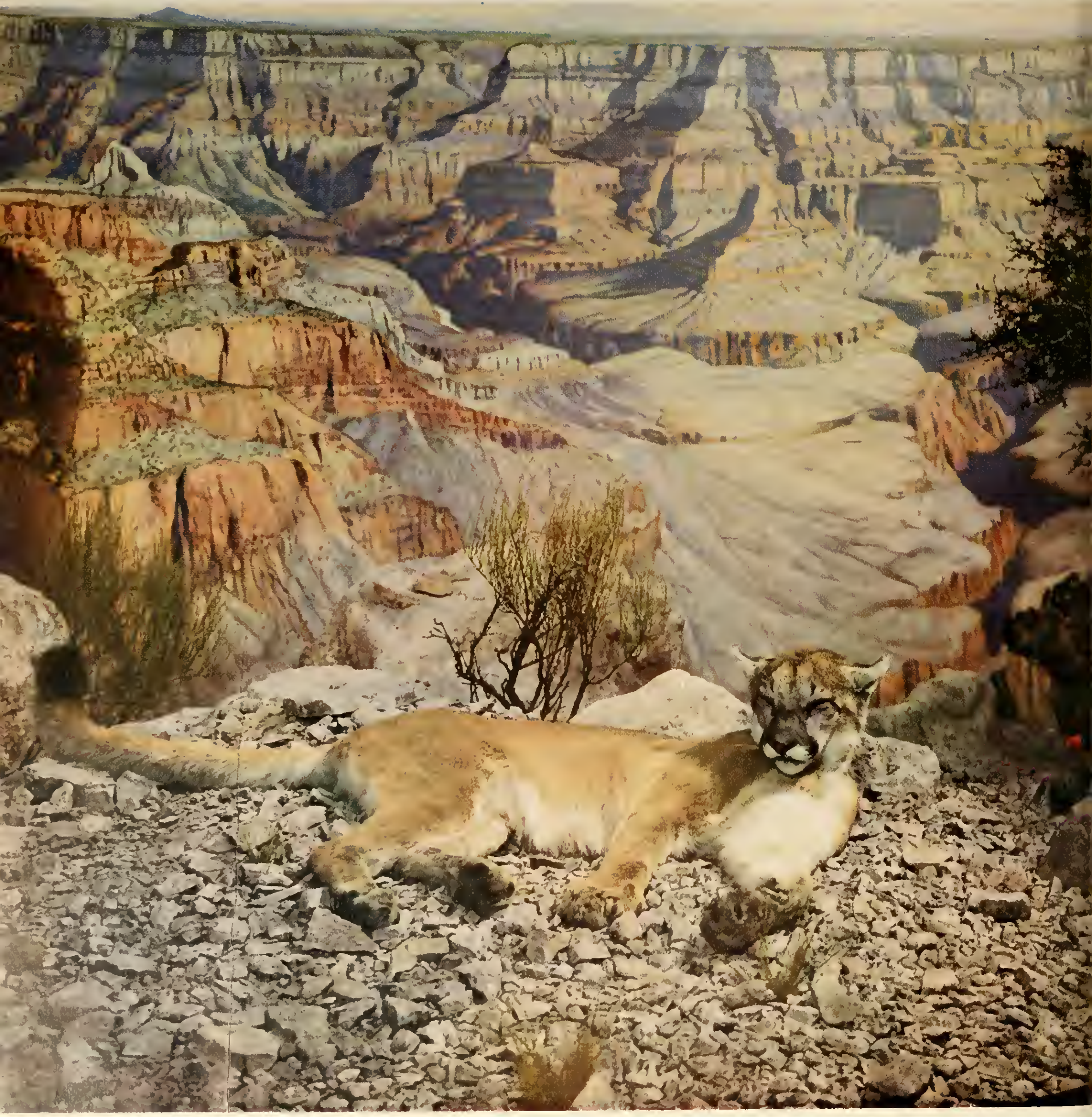
THE AMERICAN MUSEUM
OF NATURAL HISTORY

The American Museum of Natural History *PRESENTS*

A GRAN

(Below) One of the most difficult animals to
in the wild, the cougar or mountain lion is
played in the new hall with dramatic real
amid the spacious grandeur of the Grand Can

From a Kodachrome by Thane Bierwert



OUR OF NORTH AMERICA

As on a magic carpet, the city-dweller can view the wildlife of our continent from Mexico to the Arctic in the new Hall of North American Mammals

By HAROLD E. ANTHONY

Curator, Department of Mammals,
The American Museum of Natural History

THE splendid animals that are native to our continent, the scenic wonders that form their natural background in the wild, and the valuable lessons that can be learned from Nature, particularly in the conservation of our national resources—all these make the new Hall of North American Mammals a most important addition to the world-embracing exhibits in the American Museum of Natural History.

A hall depicting the life of our own continent had long been needed. In comparison with the modern halls devoted to African and Asiatic wildlife, our exhibits on North America were shabby and inadequate. The interest in our own North American fauna demanded that we do as well by the natives as by the aliens. The plan was set in motion, and eighteen separate expeditions, ranging from Mexico to Ellesmere Land north of Baffin Island and from the Atlantic Coast to the Pacific, have contributed to its realization.*

Embracing the expanse of North America thus covered, the new hall will bring to New York an impressive series of vistas into the best of primeval North America. Each animal group is an attempt to portray one or more species of mammal in an outstanding scene from the great outdoors. Many of these settings, such as Yellowstone Park, are favorite places of the tourist—regions selected by the government as National Parks because of their unique scenic and environmental values. Others are off the well-traveled routes. Mountain, desert, and arctic tundra, woodland and prairie—all types of geographic environment are represented in this comprehensive series of exhibits.

The selection of animals to go into the Hall has called for the most careful consideration. Animals having the greatest interest to the largest number of visitors have been given the most important positions. The hall has 29 alcoves, some of them very large. While the list of mammals in North America is a long one and no hall could show them all, even the lesser animals are properly represented in the smaller display groups. Whereas Akeley African Hall has a main hall and a balcony to devote to its exhibits, North American Hall achieves a practically equivalent display on one floor, as will be noted on the sketch plan of the groups.

This new hall is more than a hall of North American mammals. It is a hall of North American geography in a broad sense, a hall of North American ecology, with botany and all of the other environmental factors receiving the utmost attention. In planning the Mountain Lion Group, for example, the setting had to be one where this large cat was perfectly at home, a place where he belonged. The locality selected is the Grand Canyon. The lions themselves in the group are the obvious center of interest for the visitor; but they are only a single element out of many contained in the display. Beyond the lions, as far as the eye can see, stretches the breath-taking grandeur of the Grand Canyon, with the San Francisco Mountains in the distance, a spectacle unmatched anywhere in the world. It has been truthfully stated that no painting can do justice to the Grand Canyon. But a person in New York cannot see the Canyon itself, and this group is by all odds the next-best thing to being on the North Rim in person.

The casual visitor views the background in terms of enjoyment and entertainment, but a geologist sees in it a marvelous example of stratigraphy and of erosion on a stupendous scale. A student of botany or ecology—the science of plants, animals, and environment in their relation to each other—sees other things. He sees the flower known as the cliff rose growing out of the rock in the foreground, the cactus near at hand, the arid aspects of the landscape, and

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*Credit for the new Hall of North American Mammals is shared by several organizations and many individuals. Without the financial support given by the City of New York and the interested co-operation of the Mayor, the Comptroller, and of the Commissioner of Parks, the American Museum would not have had the building and the physical equipment for the hall. A special advisory committee for the hall has been in existence since the plans were in the blueprint stage. The late Madison Grant was chairman of this body for some years. Since active construction was begun the committee has been as follows:

Robert Earll McConnell, Chairman
Childs Frick
Douglas Burden
Beverley R. Robinson
E. Roland Harriman
H. P. Davison
Malcolm P. Aldrich
H. B. Clark
Richard K. Mellon
Harold E. Anthony
James L. Clark

the lack of any vegetation on many of the slopes, demonstrating that erosion of the land proceeds unabated when there is no ground cover to check it.

The new Hall of North American Mammals should appeal to all classes of visitors. To many the exhibits will be entertainment, which is certainly an important criterion for Museum exhibition. It is especially important during this period of world-wide turmoil, when the daily press and the radio continually impress one with man's destructive powers and when there are so few releases from the war psychology. Even in a war-mad world, the outdoor man knows that, at such times as he can escape the sphere of man's domination, he will find the sun still shining, the plants and trees still green or budded with promise, and the animal life still pursuing the same pattern of life as during times of peace. The finer things of Nature are immutable, and man will be the better for it if he can divest himself of his own interferences with the universe and get back to first principles. The habitat groups of North American mammals will offer a valuable refuge and an opportunity for eyes weary of city streets to enjoy a grand tour of the North American continent. For a while at least, the visitor can lose himself in communion with Nature. He will not find it difficult to forget the barriers of glass and wood. The life-like animals are poised for action, and the illusion is so successful that one has the impression of observing living animals in their natural homeland, at closer range than is often offered the naturalist in the field.

Children will see for the first time many of the animals of our continent. They will learn the simpler facts in the life history of the animals from visual observation of the group and from the accompanying label. Many of the scenic backgrounds would remain an unknown world to them, unless they came to the Museum. Adults in search of education will get more from the groups in measure as their individual backgrounds afford the basis for interpretation, and in the direction their curiosity leads them. The sportsman needs little beyond the immediate visual stimulation to grasp the meaning of an exhibit showing an animal he has hunted.

For many visitors, the educational value of a museum is more effective if it is not too obvious and if it is sugar-coated. If exhibits are openly displayed as lessons, many visitors will turn aside because they are not in the mood. But even the individual frankly in search of entertainment is educated unconsciously if the exhibit is planned along the proper lines. Students or classes using the Museum for source material will find that the new hall offers great opportunities.

A great deal of special information can be given in guide leaflets. It is impossible to set forth on a label all the facts covering one of these habitat groups. Labels must be restricted to a size and prominence that will not compete with the group itself and act as a distracting influence in the hall. The beauty and the illusion of reality are lost if large, conspicuous labels catch the eye at every turn. They are like briliant signboards in the wilderness, and few would come to a museum on the primary appeal of labels. But the visitor can keep the guide leaflet to read at his leisure, if he does not care to do so at the side of the group while he is in the Museum. An outline or a syllabus will probably best serve the class in nature study, in ecology, or in geology. Such an outline would point out the salient facts as demonstrated in each group. It might suggest the best order in which to study the groups and refer to supplementary information that can be derived from other halls in the Museum and from collateral reading. The education and inspiration are there for those who seek them, for in these exhibits the visitor "Finds tongues in trees, books in the running brooks, sermons in stones."

The sex and age of the animals making up a group, as well as the posing of them, must be carefully planned in advance. A popular idea is to show male, female, and young, thus stressing the family associations. An invariable adherence to this pattern, however, would become monotonous and would prevent the display of much more interesting attributes. For example, male deer are most impressive in the fall of the year when their antlers are at their prime. At this season the young, on the other hand, are no longer tiny, spotted creatures; hence a fall group of buck, doe, and spotted fawn would be a biological misfit. This illustrates in a simple way a multitude of considerations, which extend to include flowers and other seasonal vegetation in an authentic group. Or again, among mountain sheep the rams with their massive horns are so much more eye-arresting than the ewes that they draw the limelight on any stage they occupy. Furthermore, during a large part of the year the big rams range in small groups apart from the ewes, so that it is good natural history plus good showmanship to plan a sheep group with the rams monopolizing the attention. Mountain sheep live in precipitous rugged topography, and as a foil against the mighty mountain background the powerful and majestic rams get first call on the foreground. The composition of the various groups can be studied, along with the explanations accompanying them, in the pictorial section following this article.

Though less than half of the groups are completed, the hall will be opened to the public on April 9th. Work is far advanced on five other large groups, and a beginning has been made on still others. Since the construction of such a large hall is an operation requiring years, the committee in charge decided to open it in advance in order to get the maximum use of the results. This will also enable visitors to see something of the groups under construction. To most people the actual creation of a group—the painting of the background, the assembling of the accessory material, the composing of the group itself—are matters of great interest. And the appreciation of the end product is increased if one has noted the careful and laborious steps by which it has been achieved.

None of the smaller groups have been completed, but these will round out the full picture of the animal life of our continent. And let no one think that because they are small they are of minor consequence. With the larger mammals, which are the game animals, the time of the year must invariably be fall, winter, or early spring. At any other time than the period of cold weather the pelage will be shabby or antlers will be unprime or missing completely. In the case of the smaller mammals these factors are not disturbing, and one can select a season when Nature has furnished a more gracious environment. Whereas a large mammal like the bison wears a worn or shedding coat in early summer, a skunk or a jack rabbit makes an altogether satisfactory exhibit at that season. Consequently, the smaller groups can go around the calendar and will provide the hall with spring and summer barkgrounds.

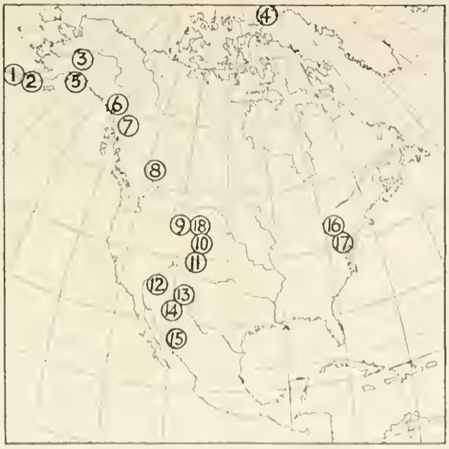
The average person who is familiar with the North American mammals of today does not realize the great variety of animal life from which they are survivors. Many mammals which now exist only in the eastern hemisphere had representatives in North or South America some thousands of years ago in the Pleistocene, or Ice Age. Sportsmen who marvel at the great variety of animals living in Africa today are interested to learn that our North American fauna of geologic yesterday was equally extensive and that many species have been lost with the advent of the Recent epoch. To give a brief survey of the predecessors of our existing North American mammal fauna, it is planned to have introductory exhibits at the entrance to North American Hall. These exhibits will show a few of the absentee members and give the visitor a better insight into the former riches of our continent.

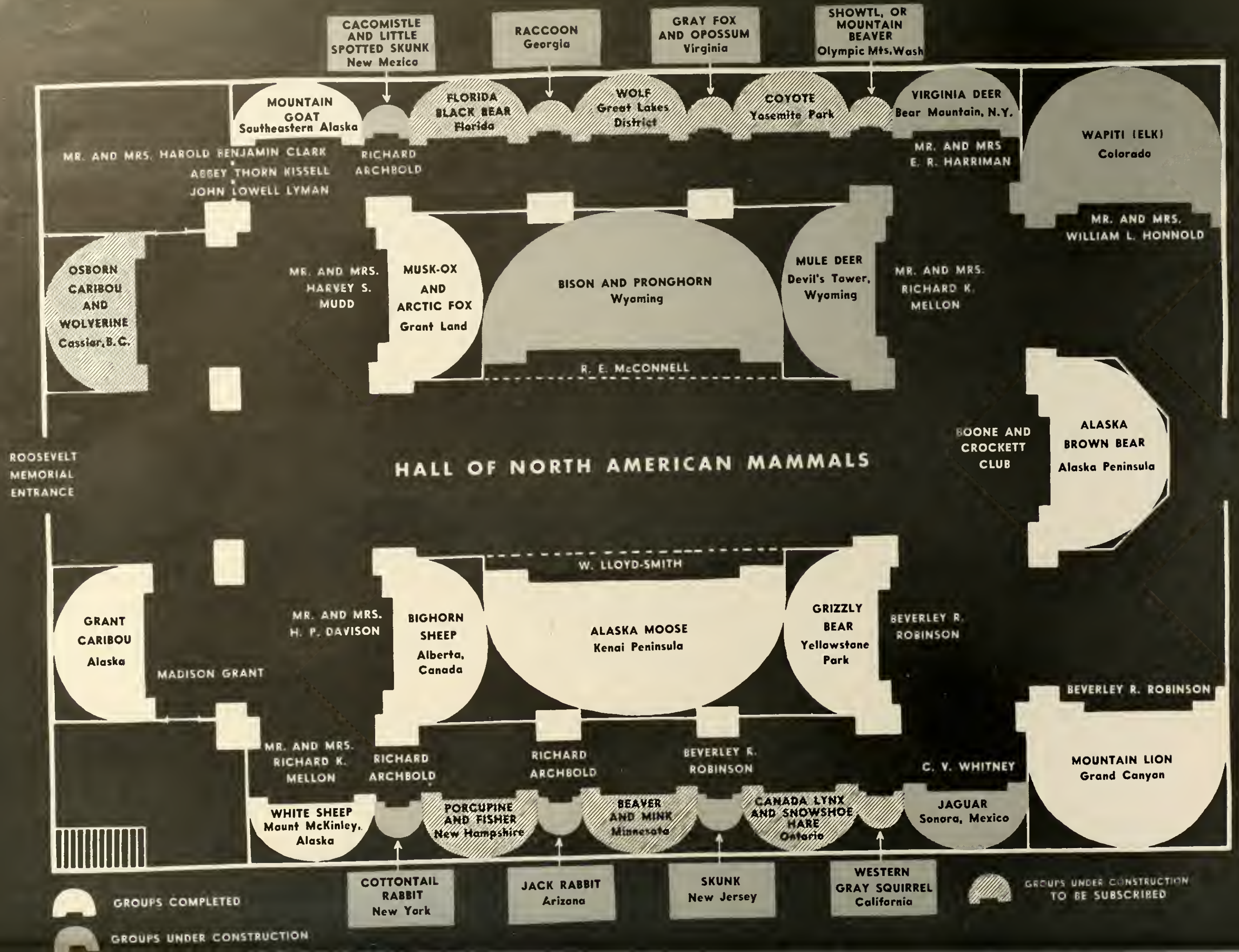
Other features of the hall which are planned but which will not be evident at the opening are the charts, maps, and diagrams which will be placed upon such of the walls as permit. These two-dimensional exhibits will cover a multitude of subjects having a direct bearing upon the distribution, evolution, and significance of the mammals on display. No class of animals can be discussed in the fullest terms if held apart from such fundamental factors as vegetation, climate, and topography. To understand the causes which make mammals look and act as they do, one must know something of their environment and of the forces which work upon all living matter. Many of the casual relations in this complex problem are yet to be discovered or formulated, but there are many factors which by association appear to have profound effects. Information of the latter character, such as distribution of forests, rainfall, desert, etc., will be given in chart form in some of these wall exhibits. The evolution of special structures or adaptations, such as the development of antlers through the life history of an animal, will also lend themselves to graphic display; and the rate of increase or decrease of various animals will illustrate many principles closely connected with the conservation of wildlife.

The pages following this article will show the reader something of the wide variety of informative and artistic material which makes the hall of North American mammals the foremost exhibit of its kind in the world. It will be open to the public on April 9th, and all are invited to come to see and enjoy it and benefit by its inspiration.

The work of eighteen expeditions is embodied in the displays in the new hall, and others will follow.

1. ALASKA BROWN BEAR
2. GRANT CARIBOU
3. WHITE SHEEP
4. MUSK-OX
5. MOOSE
6. MOUNTAIN GOAT
7. OSBORN CARIBOU
8. BIGHORN SHEEP
9. GRIZZLY BEAR
10. MULE DEER
11. WAPITI (ELK)
12. MOUNTAIN LION
13. CACOMISTLE & SPOTTED SKUNK
14. JACK RABBIT
15. JAGUAR
16. COTTONTAIL RABBIT
17. VIRGINIA DEER
18. BISON & PRONGHORN




CACOMISTLE AND LITTLE SPOTTED SKUNK New Mezico
RACCOON Georgia
GRAY FOX AND OPOSSUM Virginia
SHOWTL, OR MOUNTAIN BEAVER Olympic Mts. Wash
MOUNTAIN GOAT Southeastern Alaska
FLORIDA BLACK BEAR Florida
WOLF Great Lakes District
COYOTE Yosemite Park
VIRGINIA DEER Bear Mountain, N.Y.
WAPITI (ELK) Colorado
MR. AND MRS. HAROLD BENJAMIN CLARK
ABBEY THORN KISSELL
JOHN LOWELL LYMAN
RICHARD ARCHBOLD
MR. AND MRS E. R. HARRIMAN
MR. AND MRS. WILLIAM L. HONNOLD
OSBORN CARIBOU AND WOLVERINE Cassiar, B.C.
MR. AND MRS. HARVEY S. MUDD
MUSK-OX AND ARCTIC FOX Grant Land
BISON AND PRONGHORN Wyoming
MULE DEER Devil's Tower, Wyoming
MR. AND MRS. RICHARD K. MELLON
R. E. McCONNELL
ROOSEVELT MEMORIAL ENTRANCE
HALL OF NORTH AMERICAN MAMMALS
BOONE AND CROCKETT CLUB
ALASKA BROWN BEAR Alaska Peninsula
W. LLOYD-SMITH
GRANT CARIBOU Alaska
MADISON GRANT
MR. AND MRS. H. P. DAVISON
BIGHORN SHEEP Alberta, Canada
ALASKA MOOSE Kenai Peninsula
GRIZZLY BEAR Yellowstone Park
BEVERLEY R. ROBINSON
BEVERLEY R. ROBINSON
MOUNTAIN LION Grand Canyon
MR. AND MRS. RICHARD K. MELLON
RICHARD ARCHBOLD
RICHARD ARCHBOLD
BEVERLEY R. ROBINSON
C. V. WHITNEY
WHITE SHEEP Mount McKinley, Alaska
PORCUPINE AND FISHER New Hampshire
BEAVER AND MINK Minnesota
CANADA LYNX AND SNOWSHOE HARE Ontario
JAGUAR Sonora, Mexico
COTTONTAIL RABBIT New York
JACK RABBIT Arizona
SKUNK New Jersey
WESTERN GRAY SQUIRREL California
GROUPS COMPLETED
GROUPS UNDER CONSTRUCTION
GROUPS UNDER CONSTRUCTION TO BE SUBSCRIBED

THE HALL OF NORTH AMERICAN MAMMALS

This panoramic exhibit of the animals of our continent in their natural settings embodies the latest and most progressive principles in scientific display.

Beginning some 30 years ago, a new ideal was envisioned in museum exhibiting. This ideal aspired to achieve new educational purposes through the realistic portrayal of wildlife in scenes of artistic beauty. Its realization depended upon the development of an elaborate new technique, and its watchwords have been truth, beauty, and faith in the value of Nature's lessons to man.

Many of the artists who helped to develop the method have also contributed their talents to the creation of this hall, which is thus a monument to their collective efforts and a climax in the evolution of a unique art. In admiration of its present and future implications, NATURAL HISTORY Magazine extends sincere tribute to their names.

ART AND TECHNICAL DIRECTION

James L. Clark
Albert E. Butler

SCIENTIFIC DIRECTION

Harold E. Anthony

ON THE PAINTING OF BACKGROUNDS

JAMES PERRY WILSON	Grizzly Bear Bison and Pronghorn Wapiti (Elk) Jaguar
FRANCIS LEE JAQUES	Musk-ox
BELMORE BROWNE GEORGE BROWNE assisting	Alaska Brown Bear White Sheep Bighorn Sheep Grant Caribou Osborn Caribou
CHARLES S. CHAPMAN	Mountain Lion
CARL RUNGIUS	Alaska Moose
JOSEPH M. GUERRY	Mountain Goat
FRED SCHERER	Virginia Deer Assisting on Bison and Pronghorn

ON THE MOUNTING OF ANIMALS

ROBERT H. ROCKWELL	Alaska Moose White Sheep Bighorn Sheep Grant Caribou Wapiti (Elk) Bison and Pronghorn Osborn Caribou Musk-ox Alaska Brown Bear
GARDELL D. CHRISTENSEN	Mountain Goat Grizzly Bear Virginia Deer Osborn Caribou Mountain Lion
GEORGE ADAMS	Mountain Lion Jack Rabbit

ON THE BUILDING OF THE FOREGROUNDS

GEORGE E. PETERSEN	Wapiti (Elk) Grizzly Bear
G. FREDERICK MASON	White Sheep Mountain Lion Alaska Moose Musk-ox Alaska Brown Bear Wapiti (Elk) Grant Caribou Osborn Caribou Bison and Pronghorn Bighorn Sheep
JOSEPH M. GUERRY	Mountain Goat Alaska Brown Bear Bighorn Sheep
PAUL M. WRIGHT	Jaguar Bighorn Sheep
CHARLES B. TORNELL	Bison and Pronghorn Wapiti (Elk) Bighorn Sheep
BERNARD F. CHAPMAN	Grizzly Bear
RAYMOND H. DELUCIA	Mountain Lion Grizzly Bear Bighorn Sheep Jaguar
JAMES CARMEL	Alaska Moose

Since the realistic effect of these displays depends to a great extent on special techniques in illumination, particular credit is due the Museum's departments of Construction and Lighting.

Alaska Brown Bear

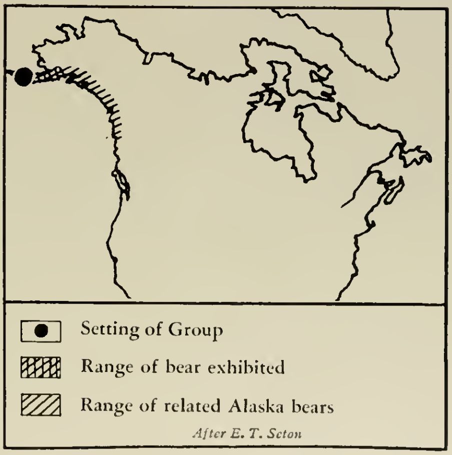
Ursus gyas Merriam

This huge bear is the first figure you will see upon entering the new Hall of North American Mammals. Its gigantic form, viewed against a background of towering Alaskan peaks, staggers the imagination. The Alaska Brown Bear sometimes weighs over 1600 pounds and is the world's largest carnivore. In ferocity, however, it does not have the reputation of the grizzly. Its great size is probably related to its abundant food supply. Hoards of salmon *(foreground, below)* run all summer, and the plentiful vegetable food of late spring and late fall is supplemented by mice, marmots, and carrion.

The brown bear goes into hibernation high on mountain slopes, sometimes as late as November, and emerges in April or May. These two males have just come down to the warm lowlands where there is more food. The cubs remain with the mother for about two years and apparently take six or seven years to reach full size.

By the stream at right is seen a Pacific land otter, found from Oregon to Alaska. It swims in a series of leaps and dives, and likes to play on snow or clay "slides," down which it coasts on its chest headfirst into the water.

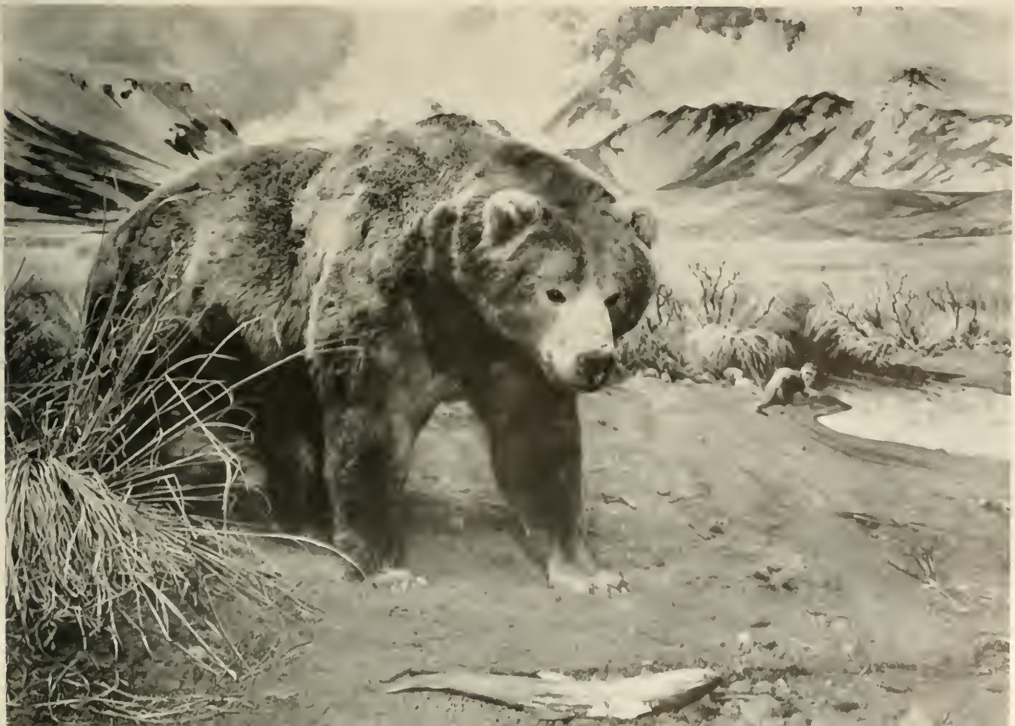
The volcanic mountainous background of this wonderful scene on the Alaska Peninsula dramatically illustrates the scooping action of glaciers and snow fields in producing **U**-shaped valleys and cup-like cirques.

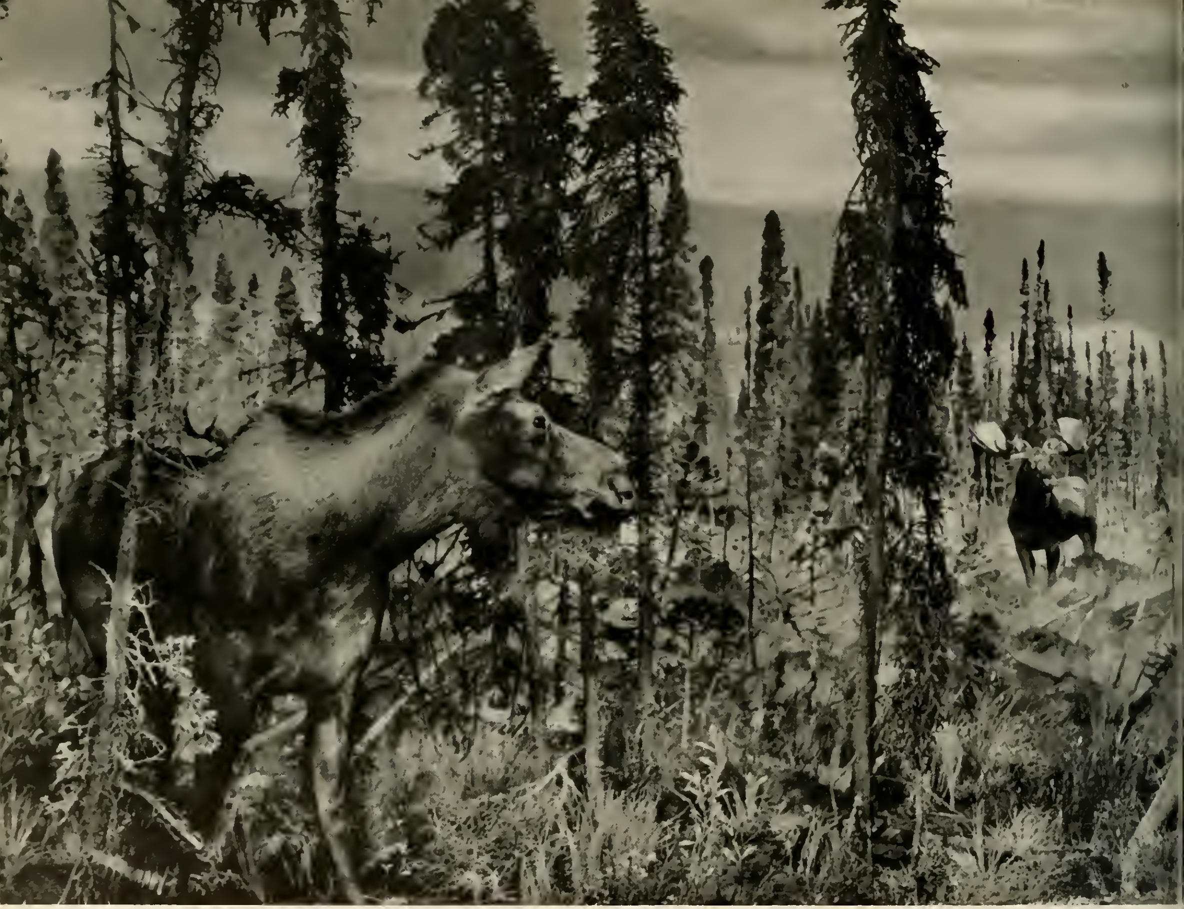


After E. T. Seton

The descriptive text accompanying these displays was assembled by Natural History Magazine from information prepared for the hall by George G. Goodwin, G. H. H. Tate, T. Donald Carter, and John Eric Hill

AMNH photos by Thane Bierwert





Moose

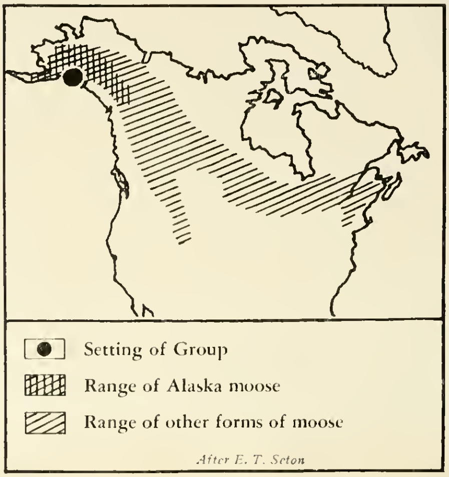
Alces gigas

Moose are the largest and grandest of the deer family. In the Kenai Peninsula and neighboring regions of Alaska, they reach their greatest size both in stature and in horn development. The antlers on the bull on the right in this group represent the world's record in size and have a spread of 77⅝ inches. New antlers are grown each year; the females have none. Males stand as high as six and one-half feet at the shoulders and weigh as much as 1400 pounds. The females are only about three-quarters as large as the males. Moose are found in nothern Europe, Asia, and North America.

During the mating season terrific battles occur when two rivals encounter each other, as shown above. The noise of a moose crashing through brush and fallen timber, pausing occasionally to thrash at the shrubbery with his antlers, gives one the impression that nothing can stop his massive advance.

Aside from man, the chief enemy of the moose is the wolf. The calves sometimes fall prey to bear and mountain lion.

Moose are forest-loving animals and prefer country with numerous lakes. In summer they enjoy wading into these lakes for protection from flies and mosquitoes and to feed on water plants. Moose are chiefly browsers, feeding on the bark, twigs, and leaves of maples, birches, alders, and willows.



After E. T. Seton

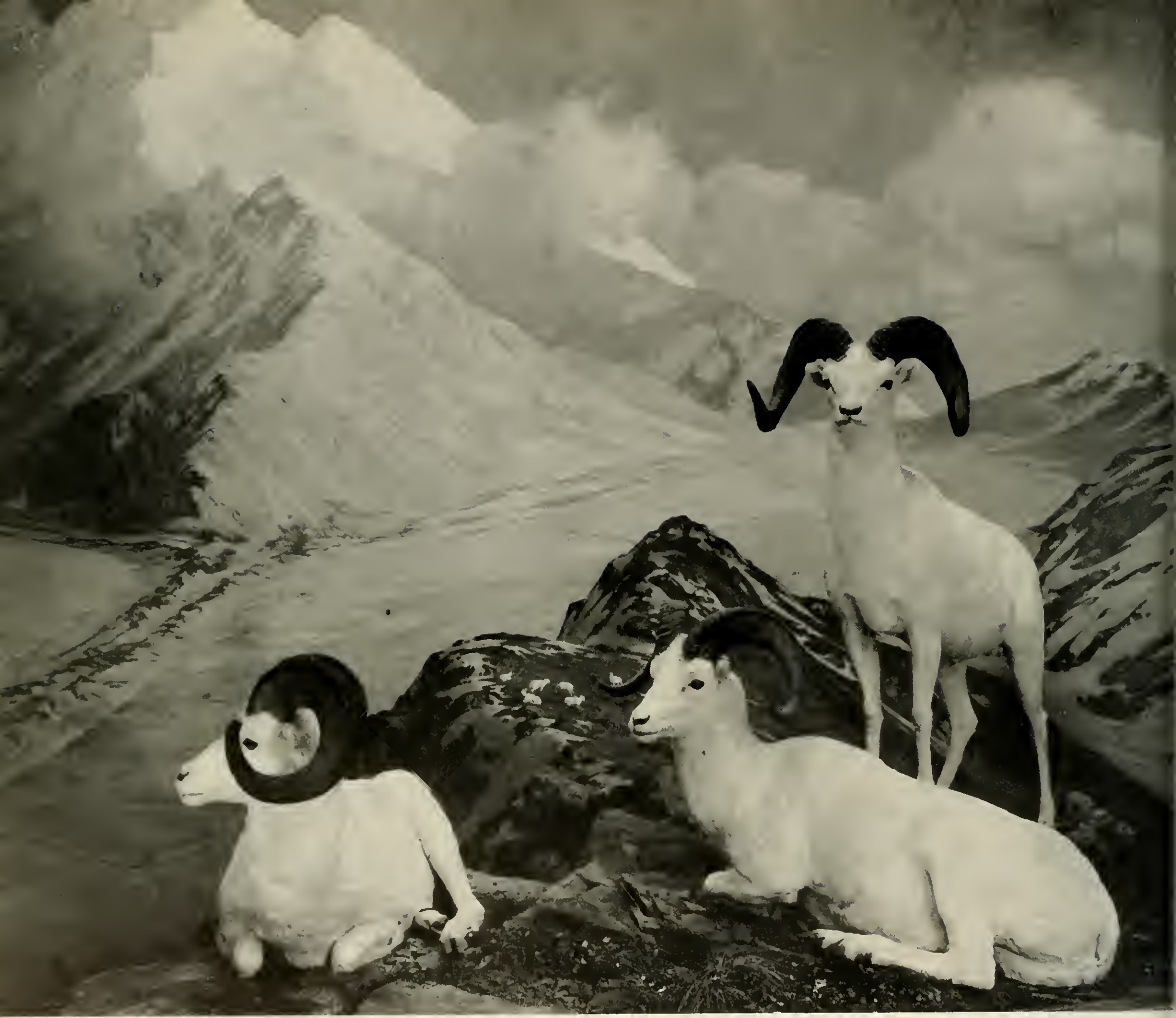
AMNH photo by C. H. Coles and R. E. Logan

Bison and Pronghorn

Bison bison bison and *Antilocapra americana americana*

The photograph below is of a miniature model and illustrates the painstaking care with which every step is planned in the construction of a group. This exhibit, now nearly completed, faces the Moose Group along one side of the long central corridor of the Hall of North American Mammals. The scene is a historic one in Wyoming near where the famous Overland Trail crossed the North Platte River. It shows the well-known American bison, or buffalo, which once roamed over our Great Plains in countless millions, and the graceful pronghorn. The latter is the only antelope in the world with branched or pronged horns.

AMNH photo by Julius Kirschner



AMNH photo by C. H. Coles

White Sheep

Ovis dalli Nelson

The massive curling horns tell you that these are mountain sheep. Their pure white color indicates that they come from the North. Throughout Alaska, the coat of this animal is all white except for an occasional brownish stain. Farther south, in the Yukon, the coat darkens, until finally in northern British Columbia a very dark sheep is found. This sheep is the subspecies known as *stonei*, or Stone's sheep.

These animals are expert mountain climbers and are not found away from steep and broken country. They are extremely sure-footed and climb up and down precipitous slopes where a man could not hope to pass. The sound of dislodged stone may be the first notice that they are above, though the adult may indicate its presence by a snort, or the kid by a shrill blat. When frightened, their tendency is to climb to the most inaccessible cliffs for protection. They have keen vision and depend more upon their eyes than upon their ears or nose to detect an enemy.

White sheep live only above timber line and spend their lives in a limited area, descending from higher altitudes only when forced down by snows. They are active throughout the year and may be seen at any hour of the day, but they often lie down to rest or take the sun after feeding in the early morning, to resume grazing only late in the day.

Although these animals are true sheep, their coat is hairy and not woolly. The horns of the females are smaller.

A superb coat of heavy hair protects the musk-ox from the extreme winter temperatures of its arctic home, and the animal is able to secure food by pawing away the snow from the mosses and lichens on which it feeds. Unlike the Barren Ground caribou, which migrates north and south with the seasons, the musk-ox remains in the far north throughout the year.

In the Pleistocene or Ice Age, musk-oxen ranged over most of Europe, Asia, and what is now United States, but they vanished from these regions before historic times. Even in the past hundred years or so, their remaining realm in arctic America has become definitely smaller. Man is the musk-ox's worst enemy and is chiefly responsible for this.

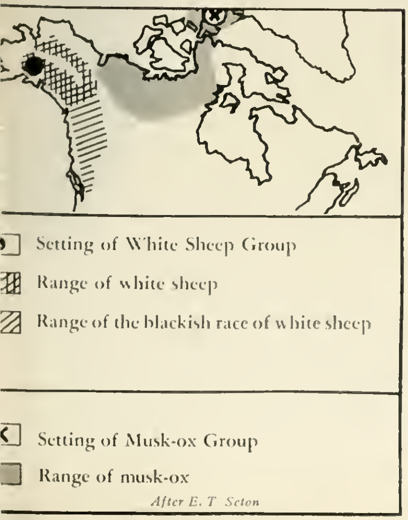
Musk-oxen are found in herds of from ten to 30, formerly in much larger ones. When attacked, the herd forms a circle with the calves in the center, thus presenting a formidable phalanx to wolves—but not to men with guns.

The shaggy coat makes it easy to overestimate the weight of a musk-ox, but bulls do weigh 600 pounds or more and measure five feet at the shoulders. One is apt to think of musk-oxen as a sort of cattle, but actually they are more closely related to sheep and goats. Their nearest relative is the Himalayan takin. Usually the cow gives birth to a single calf, late in April or May.

Musk-ox

Ovibos moschatus Zimmerman

AMNH photos by Thane Bierwert


Setting of White Sheep Group
Range of white sheep
Range of the blackish race of white sheep
Setting of Musk-ox Group
Range of musk-ox

After E. T. Seton

AMNH photos by Thane Bierwert

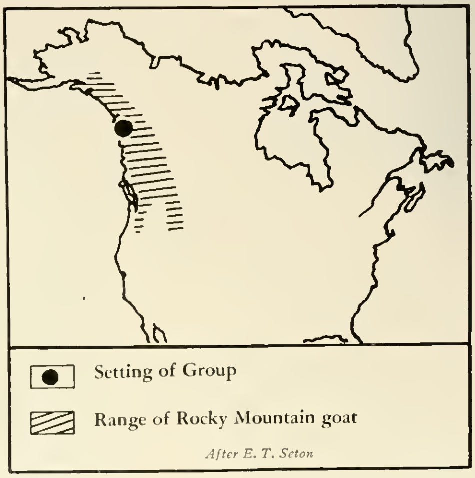
Mountain Goat

Oreamnos americanus Blainville

The mountain goat is not a true goat but belongs to the goat antelopes, or Rupicaprinae, which includes also the chamois, serow, and goral of the Old World. His home is on the high, sheer peaks of the mountains, far above timber line. His outstanding accomplishment is his marvelous climbing ability. In this he even surpasses the mountain sheep. Traveling along precarious cliffs where other animals dare not follow, he is safe from his natural enemies,—wolves, bears, and mountain lions. The eagle may occasionally take a kid but only when it is left unprotected by its mother.

The kids are born in April or May, generally one to a mother but sometimes two. Within a few days after birth they are able to follow their dams.

The food of the mountain goat consists of mosses, lichens, bushes, and grass. He does not descend into the lower levels during the winter, as do the sheep, but finds sheltered spots among the rocks for protection against storms. The crag represented above overlooks Alaska's Sawyer Glacier.



After E. T. Seton

Mountain Lion

Felis concolor Linnaeus

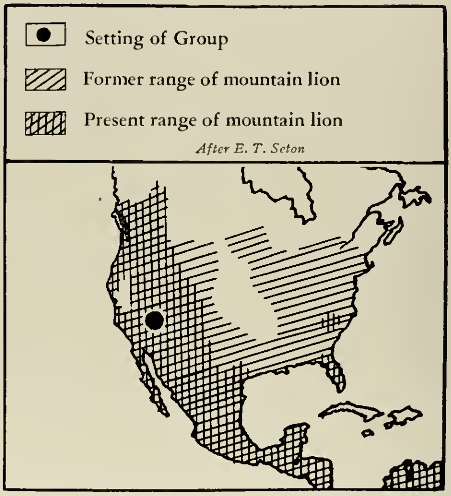
In spite of his common names, which might indicate such a kinship, the mountain lion, cougar, puma, or "panther" has no close relatives in Europe, Asia, Africa, or Australia.

In the West the mountain lion prefers rough mountainous country, but it was formerly at home throughout the forests and rocky regions wherever deer occurred, from Canada to Patagonia.

Early settlers considered the big cat dangerous, but few attacks on mankind were recorded, and only a starving or cornered cougar is to be feared. They are shy and are rarely seen, even when common. Individuals will, however, follow a man for miles and prowl around camp, apparently from pure curiosity. They are readily tamed, especially when young, and remain docile and playful.

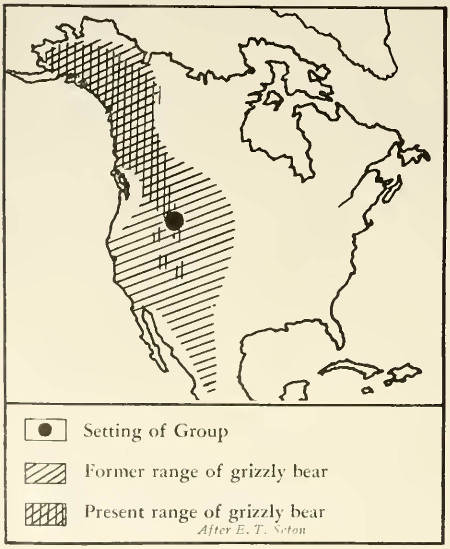
Cougars are usually found in pairs except for a short time after the birth of the young.

The background is the Grand Canyon, whose rock walls present the most complete record of earth history found anywhere in the world.


● Setting of Group
▨ Former range of mountain lion
▦ Present range of mountain lion
After E. T. Seton

Grizzly Bear

Ursus horribilis Ord


● Setting of Group
▨ Former range of grizzly bear
▦ Present range of grizzly bear
After E. T. Seton

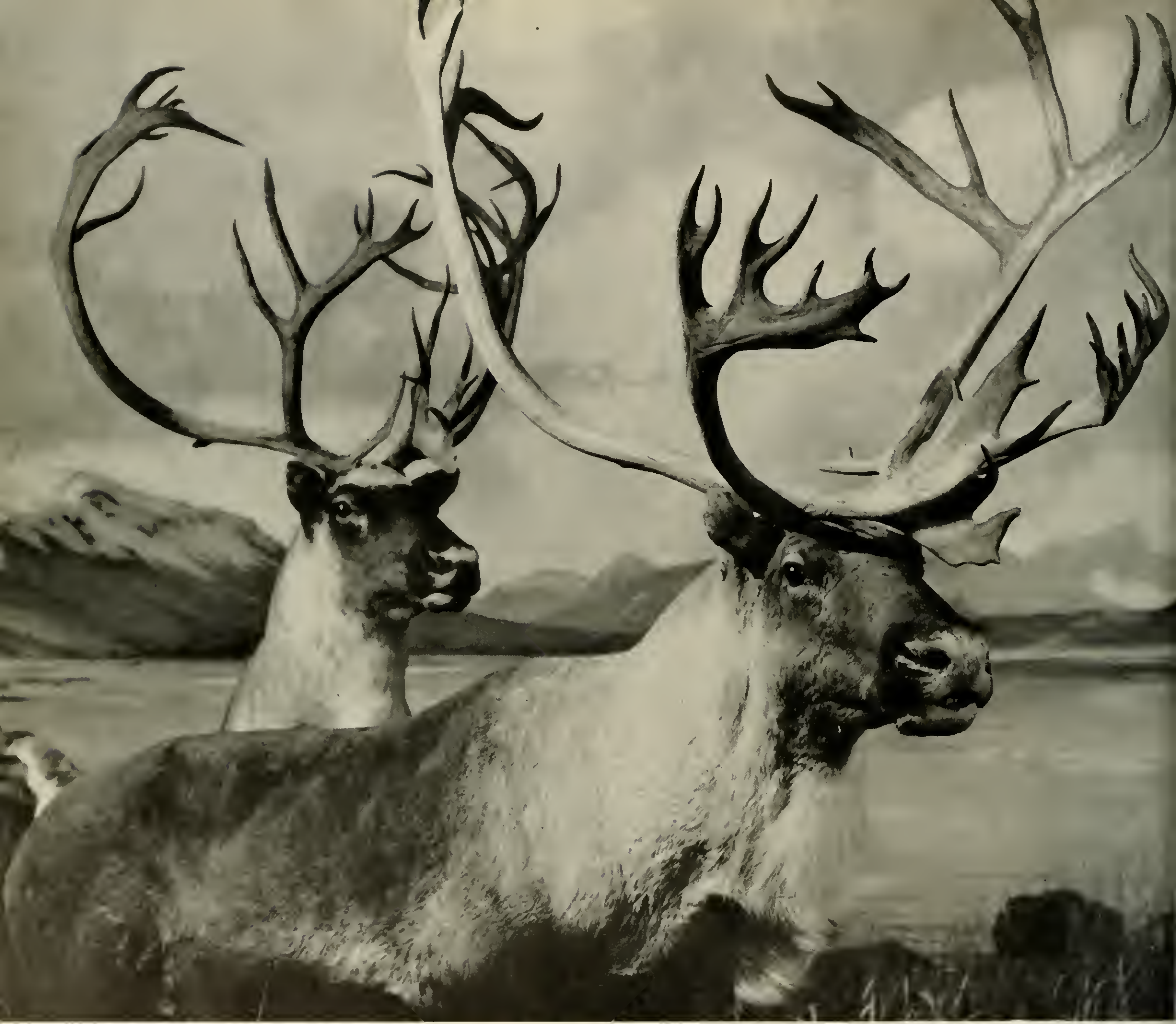
The name "grizzly" was given to this bear because of its unusual coloring. The word "grisly," meaning terrible, gruesome, or grim, was applied later but was evidently in the mind of Ord when he gave the grizzly the scientific name *horribilis*.

The grizzly bear is the most formidable and ferocious animal in North America, and yet, according to the best authorities, it rarely attacks man unless provoked. Its mentality is far inferior to that of the dog or wolf, but its powers of scent and hearing are highly developed. The favorite range of the grizzly is high rolling uplands, with rocky ridges and densely wooded thickets. Here it finds abundant food, consisting of roots, berries, nuts, insects, reptiles, fish, birds, eggs, and mammals ranging from mice to cattle. The young are born in the mother's winter den and are exceedingly small at birth. The second winter they den up again with the mother, but after that are able to shift for themselves.

Grizzly bears seem to communicate by a sort of signpost language. The bear bites a trunk high up, tearing the bark open crosswise, and often leaves five raking claw marks.

AMNH photo by Thane Bierwert

AMNH photo by C. H. Coles



AMNH photo by Thane Bierwert

Grant Caribou

Rangifer arcticus granti Allen

THE animals in this group are a variety of Barren Ground caribou that are restricted to the Alaska Peninsula; thus they belong to a group having a wide distribution over the treeless tundra of the circumpolar regions. Caribou are the only deer in North America whose females have antlers. Both sexes shed their antlers annually.

The winter coat of this animal, with its thick growth of air-filled hairs, is weatherproof and affords fine protection from the cold. The large, spreading hoofs are suited for travel over the soft muskeg in summer and the deep winter snows where other hoofed animals would sink and flounder.

The life of the northern caribou is one of continuous travel. It summers on the tundra along the Arctic coast and migrates south for the winter months in immense herds, to the border of the forest belt. In the summer its food is grass and in the winter, lichens. The mating season is October, and the young are born in June.

The most formidable enemy of this caribou is the great white wolf, but bear, wolverine, and other predatory animals take a limited toll. During the summer months insects are a great menace to all caribou.

The caribou is an important source of subsistence to the people of the arctic regions, both in food and clothing.

Bighorn Sheep

Ovis canadensis Shaw

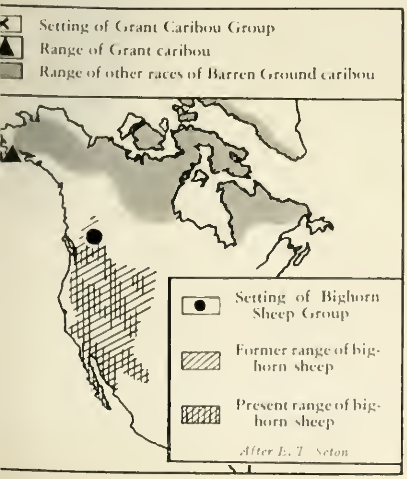
AMNH photo by Thane Bierwert

THE most coveted prize of the American big-game hunter, the bighorn sheep, inhabits the rugged mountains far above tree line and only descends when forced down by deep snow. Throughout most of the year, the older rams go about in small parties, keeping to themselves, while the ewes, lambs, and young rams form separate flocks. In late November the rams join the ewes, but after the breeding season they return to their former mode of life. The lambs are born in late May or June.

Besides man, the bighorn has many enemies. Coyotes, wolves, bears, mountain lions, lynxes, wolverines, and eagles,—all prey on the lambs, and the larger carnivores all enjoy a meal of mutton.

The horns on the right-hand ram *(also above)* are the world's record—49½ inches along the curve—and were donated by Dr. Henry M. Beck.

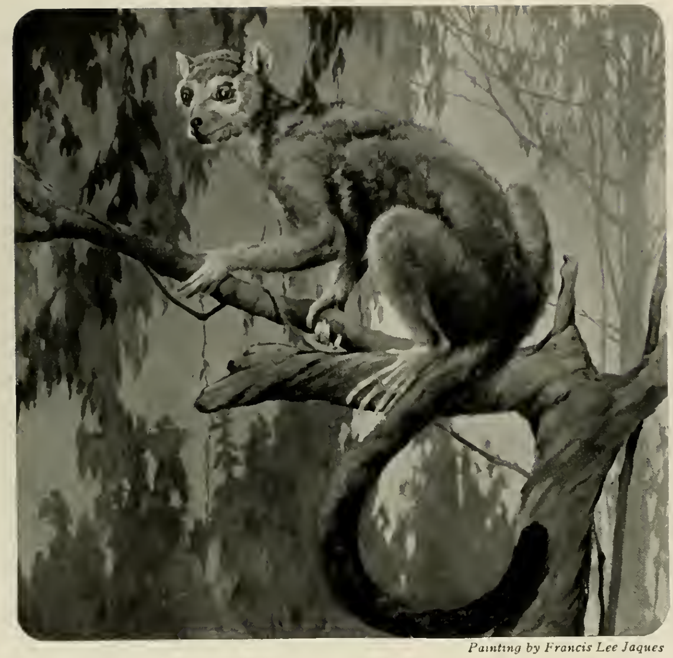
The scene is Jasper National Park, Alberta, and shows Mt. Athabaska as seen from the slopes of Mt. Wilcox at about eight o'clock in the morning.


Setting of Grant Caribou Group
Range of Grant caribou
Range of other races of Barren Ground caribou
Setting of Bighorn Sheep Group
Former range of bighorn sheep
Present range of bighorn sheep
After E. T. Seton

AMNH photo by C. H. Coles and Thane Bierwert

Sixth installment in the story of animal life

Both North America and Europe becam the scene of conflict some forty or fift million years ago when a host of nev animals swarmed in, possibly from Asia menacing all those who could not defen themselves



Painting by Francis Lee Jaques

NO MONKEYS appeared in the vanguard of the invasion, but their ancestors the lemurs were plentiful. A typical representative about forty million years ago was Notharctus, at left. Monkey-like hands, feet, and tail are characteristic of the lemurs, but the face is more fox-like. Lemurs did not survive in North or South America, but they are fairly abundant elsewhere today

No newspapers carried the headlines:

AMERICA INVADED

SHOCK TROOPS SWEEP
FORWARD

INFILTRATION TACTICS
THREATEN DEFENDERS

AMERICANS FALL BACK
WITH STUBBORN RESISTANCE

THERE were no reporters to cover this great invasion. No human eye saw it, for it occurred long before man had appeared on the earth, tens of millions of years ago: some say 40 million and some say 50 million. Yet it had a greater effect on history—yes, on human history as well as on earth history—than any of the military campaigns of the mere six thousand years or so of what we are pleased to call history.

It was not the first invasion of America and it was not to be the last, but it was in many respects the most fateful. Already incredibly old, the earth had seen many races come and go. Perhaps a billion years before this, the first protoplasmic life had moved in the dark waters. Slowly, gropingly, as aeons passed, cells had clustered together, had formed muscles, skin, nerves, and glands. Fishes appeared, equipped with a wonderful new structure, bone, that gave them internal support, solving the problem of increased size and of greater speed, providing rigid support and yet giving freedom of directed motion. Crawling out of fetid pools, gasping for oxygen, the amphibians had finally learned to breathe air during their adult life; and some of their descendants, the reptiles, had completely broken the long bondage to water, for even their eggs could be laid on land and could survive without the watery bath required by all the earlier forms.

Then had come a great time. Surely an observer, had there then been one capable of rational thought, would have decided that the goal of evolution was reached. Through the air flapped and soared ugly, bat-like pterosaurs. Swift as torpedoes, streamlined ichthyosaurs sped through the waters, while marine dragons, the mosasaurs, sported with them, and the clumsier plesiosaurs sculled more placidly along. Above all, on land the motley hosts of dinosaurs held sway. Yet all these saurians were but an incident in history, even though a long incident of perhaps 140 million years, and they vanished mysteriously and were as forgotten as if they had never existed, until their remains were dug up by curious men.

That long time when the dinosaurs and all the other -saurs lived and dominated life is called the Mesozoic. The name means "middle life," and appropriately refers to the Medieval Era, the Dark Age, of earth history. When the saurians died and the meek mammals replaced them as described in the February NATURAL HISTORY, the Cenozoic began, the "recent life" era. This was the beginning of modern history in the grand history of life, in which ten million years is like a century of human history. When students delving in the rocks first obtained some grasp of this sequence they found what seemed to be a fairly simple picture despite the multiplicity of its details. The dinosaurs were gone. Very well, that ended the Mesozoic. Mammals became abundant and no doubt they simply evolved into living faunas. So the period of that evolution can be called the Cenozoic, and for its first part no more appropriate

he Great Animal Invasion

By GEORGE GAYLORD SIMPSON

Associate Curator of Vertebrate Paleontology, The American Museum of Natural History

name could be used than Eocene, which means "the dawn of the recent."

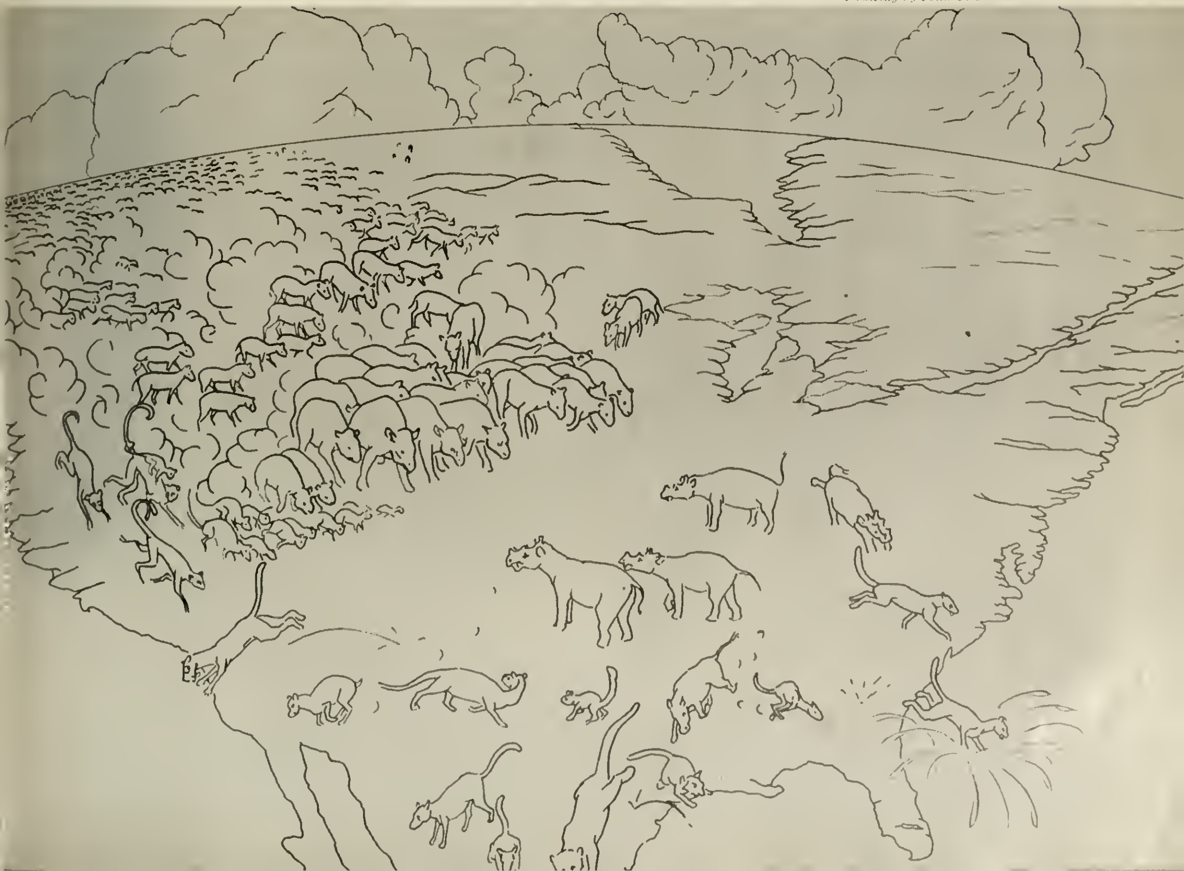
Now it is a troublesome fact that the more we know, the more we find to be known; the more we understand, the more appears that we do not understand. If they are acquiring some measure of wisdom and not merely being educated, students are likely to discover this distressing fact about the time they get into high school. Scientists, who are professional students and are paid for trying to find out a few of the multitude of things that ignorant man does not know, live all their lives with the discouraging conviction that their most distant journeys into the unknown are not much more extensive, relatively, than if they were ants setting out to explore North America.

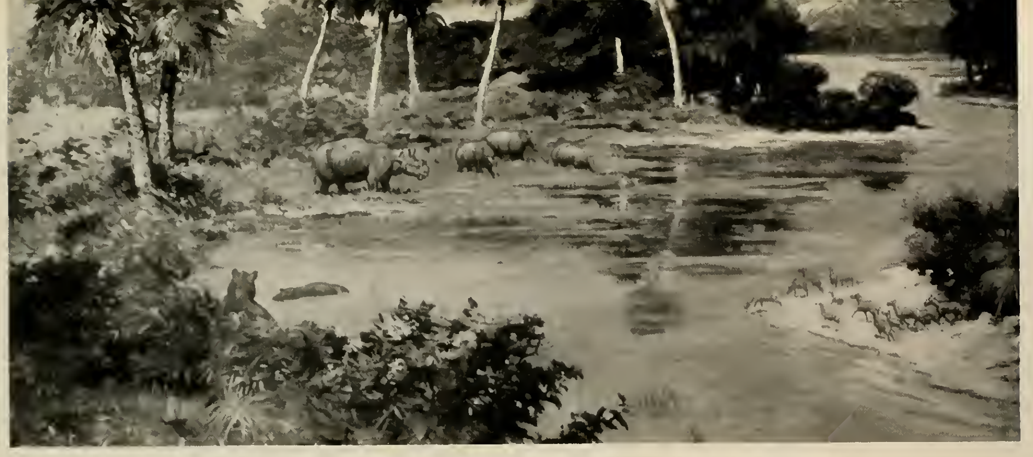
All this is by way of introducing the news that paleontologists had hardly named the Eocene and started the interesting task of tracing the descent of animals from that time to this, when they began to find facts that did not fit into the picture. They found that the Eocene did not immediately follow the extinction of the great reptiles at the end of the Mesozoic, but that some time intervened. The longer they studied, the longer this interval appeared to be, until now it is believed to have lasted for at least ten million years, possibly fifteen million. Rocks deposited in that interval are not very widespread; but now almost a complete sequence of them has been found in our Rocky Mountain states, and some strata representing more limited parts of the interval have also been found in Europe, Asia, and South America. Fossils occur in these rocks and they show that mammals were the dominant, common animals of the time.

So far, so good. This unexpected interval belongs to the Age of Mammals and fits into the Cenozoic. The name Eocene had already been given to a later epoch before it was found that this was not really the beginning of the Cenozoic, so a new name had to be coined for the true beginning and it has been called Paleocene, which means "ancient-recent." It is a rather absurd appellation if taken literally, but paleontologists agree to use it, and it serves all the purposes of a name and is less confusing than if the

NO ONE KNOWS just where the invading animals came from. South America, then separated from North America, avoided the invasion until several million years later

Drawing by John C. Germann





The grotesque archaic uintatheres *(center)* were doomed to extinction when faced by progressive invaders like the ancestral horses *(right)*

use of the more appropriate "Eocene" had been changed.

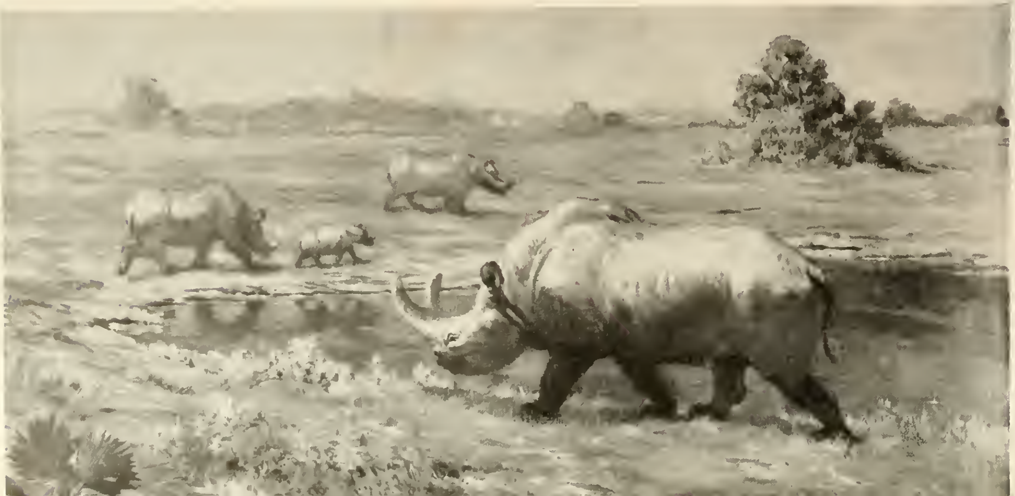
The trouble was that the mammals of this unexpected extra epoch, the Paleocene, do not simply grade into the ancestry of modern mammals. Something very queer, and at first sight inexplicable, happened at about the beginning of the Eocene. Take the ancestry of the horse, for instance. Everyone knows that this can be traced back almost continuously to little Eohippus, a small animal with four front and three hind toes that lived in Europe and North America at the beginning of the Eocene, the "dawn-horse" in the "dawn of the recent." But where did Eohippus come from? Since the long Paleocene, with its varied mammals, preceded the Eocene, obviously it is the place to look for the ancestor of Eohippus.

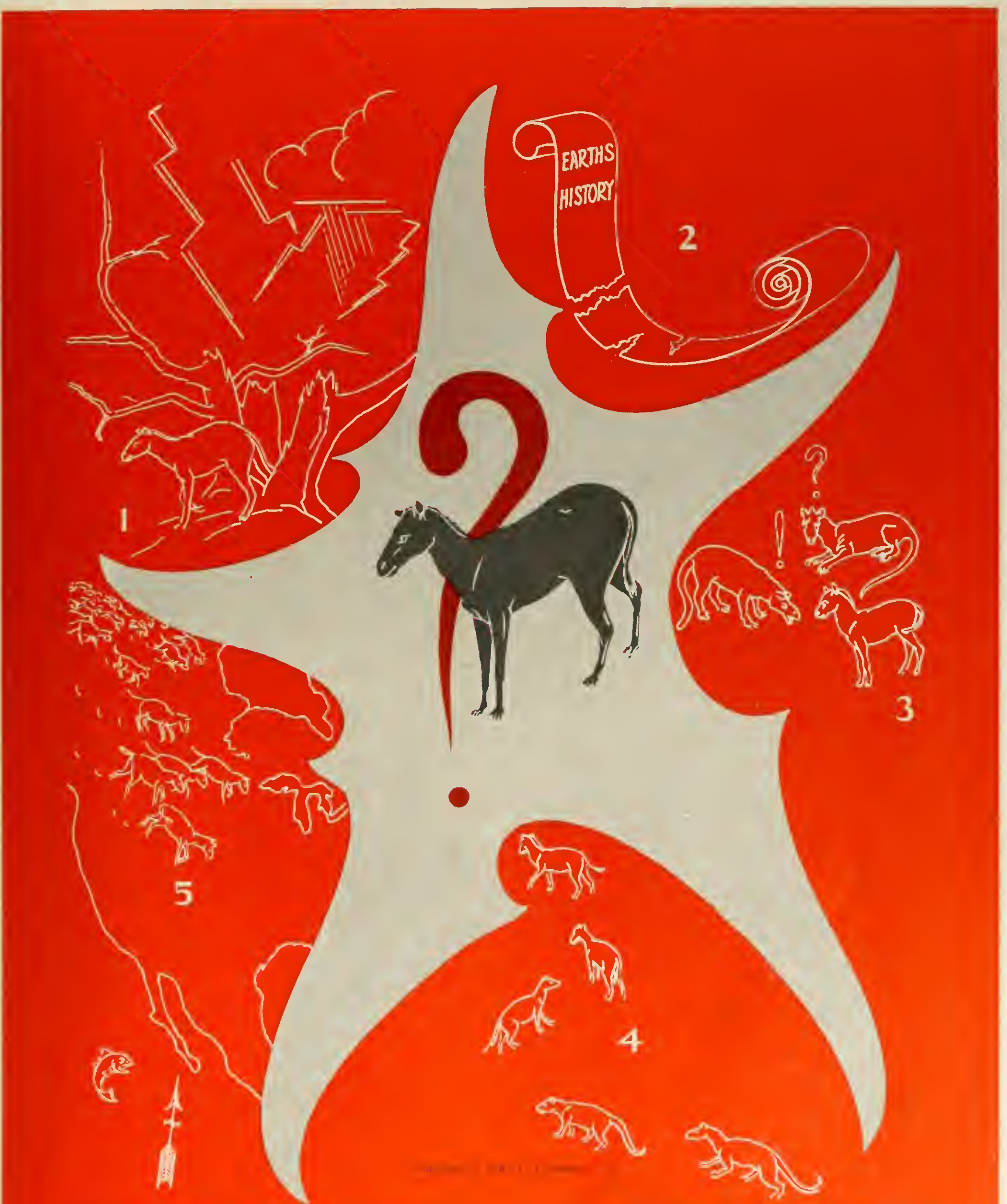
There are, indeed, animals in the Paleocene that could have given rise to Eohippus. These are the condylarths, the first hoofed, herbivorous mammals, described in the February Natural History. The problem seemed to be solved, but paleontologists continued to pry and they learned so much that they found that they knew less than they had thought. They found that the condylarths evolved slowly and steadily through the Paleocene but that when Eohippus appeared the condylarths were still here and were still much more primitive than Eohippus and quite different. Apparently these condylarths, at least those known in North America, did not evolve into Eohippus. The same sort of difficulty appeared not only for the horses, but also for all the modern types of herbivores, the pigs, cows, antelopes, and the rest, and for the rodents and for many other recent types of mammals.

Here are the makings of a game more exciting than "Murder" and more difficult than crossword puzzles. The reader can try it, if he likes, as a superior sort of guessing game. The question is: *Why does the first animal we can class as a horse differ so much from its only possible known ancestors?* The scientific method of attack on the problem does, indeed, follow some of the lines of a guessing game. A first step is to think of all conceivably possible explanations. In scientific research these are called "multiple hypotheses." You might try this yourself before reading the multiple hypotheses that scientists have set up for this particular problem. The most important of these hypotheses are:

Some of the invaders, like the great titanotheres *(below)* progressed so rapidly that they, too, became specialized and then extinct

Paintings by Charles R. Knight





FIVE HYPOTHESES are considered in explanation of why horse ancestors appeared suddenly in North America. They are:

1 that Eohippus, the Dawn Horse, was created by divine act

2 that the geologic record in North America was interrupted during the time when Eohippus was evolving

3 that certain animals unlike Eohippus but related to him, suddenly gave birth to a litter of Dawn Horses

4 that fossil hunters in North America have as yet merely failed to find the connecting links in horse ancestry, and

5 that the Dawn Horse was evolved elsewhere than in North America and arrived on this continent along with other invading animals

1. Eohippus was created by divine power and did not evolve from any earlier form. This was accepted by scientists a hundred years ago and is still claimed by a few theologians, but it cannot now be seriously considered by any thoughtful inquirer. This is no place to go over the threadbare arguments, but if you feel like arguing, mull over just one fact: the whole sequence from Eohippus to modern horse is very well known and shows beyond question that the latter is derived from the former; but some condylarths are much more like Eohippus than Eohippus is like the modern horse.

2. Eohippus did arise from condylarths in a (hypothetical) long interval between Paleocene and Eocene when no known rocks, and hence no known fossils, were deposited. This is a plausible hypothesis, but, as it happens, one that can now be disproved beyond any doubt. One of several conclusive lines of disproof is this: condylarths are known both in the late Paleocene and in the early Eocene contemporaneous with Eohippus; they are very much alike in the two epochs; if they changed so little, no length of time sufficient for the slow origin of Eohippus can have intervened.

At which point you may interrupt me to say, "How about the scare headlines with which you began this article. Was that just a come-on to get me to plow through all this stuff?"

"Not at all," I would answer. "This 'stuff' as you call it, has a very direct bearing on those headlines. We'll be back to the invasion sooner than you expect."

3. Eohippus did arise from the condylarths, but did so all at once and not slowly. Perhaps condylarth mates suddenly had a litter of Eohippuses at the beginning of the Eocene. In the nature of things, this hypothesis cannot be ruled out categorically and some respectable scientists (as it happens, not those best acquainted with the facts of mammalian history) do support it. Nevertheless it is so improbable as to be unacceptable unless we can find no hypothesis more likely to explain the observed facts. No such radical jump ever occurred in the later evolution of the horse, or in any other group represented by a good fossil record, so what logical right have we to assume that it happened here unless there is no other explanation?

4. Some line of American condylarths, evolving more rapidly than those known, did give rise to Eohippus during the Paleocene but simply has not been discovered. Again, the hypothesis cannot be disproved—who can say what may yet be discovered? It was even a likely hypothesis before much was known about the American Paleocene, but as hundreds and thousands of Paleocene fossils are found, many of them clearly from environments suitable for Eohippus, and not a scrap of a real Eohippus ancestor appears, the chance that such ancestors occurred here is being reduced to the vanishing point.

5. Eohippus evolved from condylarths some place else and it appears suddenly at the beginning of the American Eocene because something—perhaps the rise of land joining various continents—then permitted the herds of Eohippuses and other typical Eocene mammals to invade North America.

This is the favored hypothesis of paleontologists. It explains all the known facts, no fact contradicts it, and it is supported by other observations and theories on all sides. Thus it becomes something more than a hypothesis (which is a scientific guess set up for examination and testing) and becomes a full-fledged theory (the most probable, best supported explanation of a body of observations). The next step —from theory to an attested fact—would be the finding of the ancestry and the tracing of the actual steps of the invasion radiating from a center. Such a discovery has not been made. Perhaps it never will be; it is quite possible that the center of origin is now sunk beneath the sea or that no fossils survive in it. But in any case the theory is established and seems almost certainly to be true.

Ancestors from abroad

With a few exceptions, the known American Paleocene mammals were archaic types. They were related to the ancestry of later mammals and give us some idea of what those ancestors were like, but they were not themselves the real, direct ancestors. Life today would be very different if the Paleocene mammals had continued to occupy the earth and to evolve into the only living types. Hardly a single mammal that we know today would have existed. The ancestors came in during the Great Invasion.

This did not happen all at once. Some groups invaded earlier, some later, but the climax of the change came at about the beginning of the Eocene, so that the name of the "dawn of the recent" epoch is still appropriate. The archaic Paleocene groups did not die out all at once, either. Most of them were certainly doomed, because they were less efficient or less intelligent than various modernized mammals of similar habits and could not win in the long competition. Nevertheless many of the archaic mammals hung on, some of them for millions of years, and continued to evolve in their own ways before they finally succumbed.

Let us briefly review a typical mammalian fauna of, say, the middle Eocene when the invaders were well established but some of the ancient inhabitants were still holding out. A good example is the fossil fauna of the Bridger Basin of southwestern Wyoming. In the middle Eocene much of this region, now barren, was heavily forested. The animals roamed through the forests, glades, and smaller savannahs of a broad valley. Distant volcanoes thundered; falls of volcanic ash were frequent, but seldom so dense as to cause wide slaughter. To the south was a lake basin already almost filled by millenniums of ash falls and by the sediments of rivers but still with shallow open water in the middle Eocene.

To the instructed eye, perhaps the most striking animals of the time were some of the smallest, the rodents. The rodent-like multituberculates of the Mesozoic and Paleocene were among the first of the archaic mammals to fall before the invaders. Now, in the Eocene, they are all gone and in their places are multitudes of true rodents. Numerous as these are, they are not nearly as varied as are the recent rodents of Wyoming. They are still primitive, just beginning to specialize in various directions, and all are more or less squirrel-like,—for squirrels, despite a few specializations, are about the most primitive of rodents surviving today and therefore most like these ancestral forms.

Passing giants

The largest and most impressive animals are the uintatheres, almost as large as elephants and elephant-like in their bodies but with very different heads, elongate and provided with three pairs of blunt, horn-like protuberances. Although they are herbivores, they have great saber-like canine teeth and use these to fight, not to kill prey. The fate of the dinosaurs is sufficient warning that size is not adequate insurance of survival. Indeed, these grotesque uintatheres are stupid survivors of the archaic fauna and they are to die out by the end of the Eocene.

Other archaic herbivorous survivors are condylarths, so varied in the Paleocene but now reduced to one kind which is, nevertheless, abundant, and taeniodonts, strange misfits that we saw at the beginning of the Paleocene. Both these groups, like the uintatheres, are destined not to survive the Eocene.

But there are others,—more varied and more numerous herbivores of modernized groups, Eocene invaders prophetic of the future. Among these are ancestral horses, Orohippus, differing little from its immediate ancestor Eohippus. Rhinoceroses are particularly common and there are many different sorts. Ancestral tapirs also occur. There are many titanotheres, odd-toed allies of horses and rhinoceroses and therefore modernized or progressive. They evolved more rapidly to a maximum and became extinct in the next epoch, the Oligocene. Even among the modernized groups that invaded in the Eocene there were many aberrant side lines that do not survive today.

The even-toed hoofed mammals, later dominant among all herbivores, are present in this middle Eocene fauna but are still rare. As yet only a few occur, rather small and too primitive to describe in terms of recent animals. Later their evolution seems to have speeded up and they passed the odd-toed forms, giving rise to such diverse creatures as pigs, hippopotamuses, camels, deer, antelopes, sheep, cows, and many others.

Flesh-eaters largely archaic

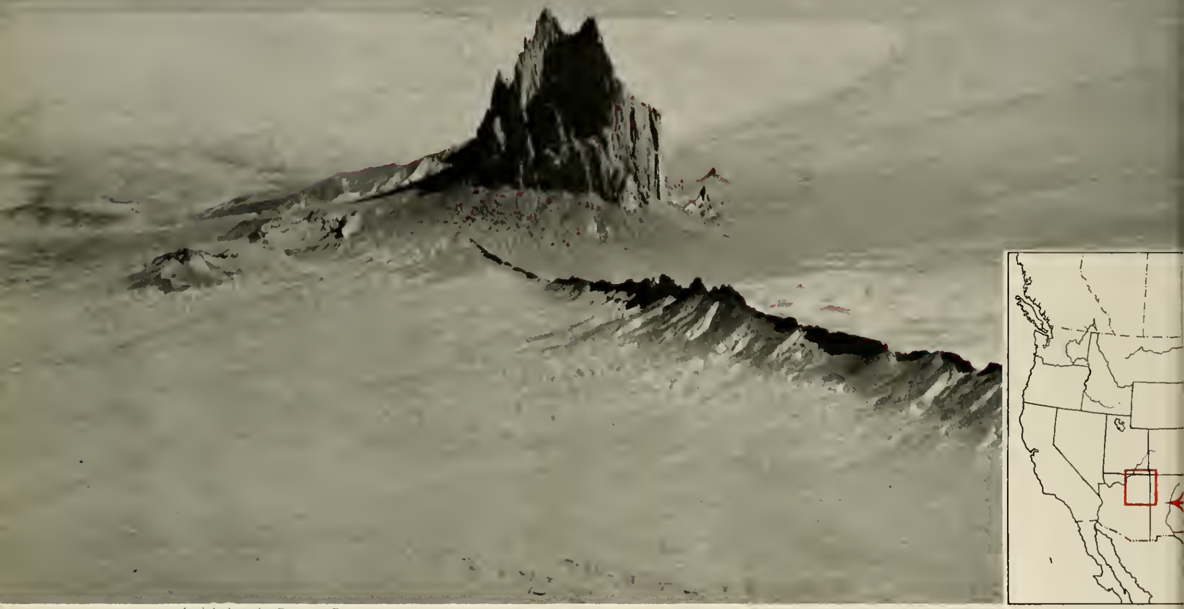
What of the flesh-eaters that preyed on all these herbivores? Here it is curious to note that the archaic types are still dominant. Varied creodonts, much like those of the Paleocene but in some cases swifter or more powerful, have developed from Paleocene ancestors without being replaced by invading modernized types. Some, indeed, are relatively advanced but the most potent invaders, of the cat, dog, and weasel families, had not yet made their way into North America. When they did, in the next epoch, the creodonts did not long survive the competition.

Perhaps the greatest popular interest is attracted by the presence of numerous primates, for this group of mammals includes the monkeys, apes, and man. None of these higher types, not even one as high as a monkey, has yet appeared in the middle Eocene; but lower primates are common, especially primitive lemurs. The lemurs, some of which still survive in the warmer parts of the Old World, have monkey-like hands, feet, and tails, but most of them have long, fox-like faces instead of the short, flattened faces so typical of monkeys—and of man, for that matter. (Our naked, smashed-in snouts perhaps look quite disgusting to a lemur.) The primate invasion started well back in the Paleocene, but the commonest middle Eocene type, a fairly typical primitive lemur called Notharctus, is of a more modern stock that invaded with Eohippus at the beginning of the Eocene. For some reason primates did not do very well in North America, where only a few survived the Eocene and none the next epoch, the Oligocene. That they survived abundantly elsewhere in the world is history.

The Great Invasion occurred almost simultaneously in Europe and North America and, as already mentioned, its source is not clear, although a number of students think that the main source, at least, was somewhere in Asia. Now it has been found that essentially the same invasion occurred in South America at a very much later date and under circumstances that permit its being followed from start to finish in considerable detail. This clear example helps to support the theory of an Eocene invasion in North Amer-

Continued on page 236

The Story of
SHIPROCK



Aerial photo by Barnum Brown

New Mexico's famous landmark is a memorial to a volcanic explosion that made the "four corners" a scene of desolation five million years ago

By H. E. Vokes

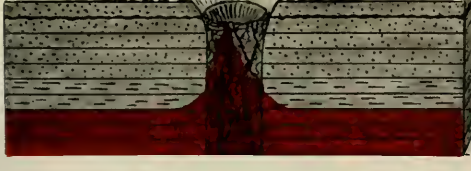
Assistant Curator of Invertebrate Paleontology,
The American Museum of Natural History

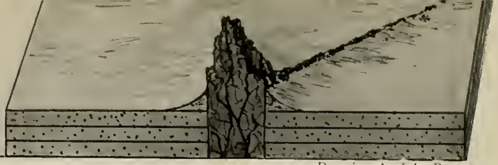
Today it is a desert region—a land of bare rocky plateaus rimmed with stark walls of rock; a land of forbidding, dry, hot valleys; of little vegetation and less water; a region of scorpions, rattlesnakes and centipedes. Some five million years ago, it was an Eden, a region with lush vegetation and abundant life, with horses, camels, mastodons, and beavers, with amphibians in its swamps and fish in its sluggish rivers; a pleasant region with a warm, moist climate.

On a summer morning, in those early days, a herd of giant camels was lazily browsing near the margin of one of the many small lakes that dotted the landscape. Suddenly and with a great roar a large portion of the land blew up and great fragments of rock were thrown high into the air. Many of the camels were killed outright, others were thrown down by the force of the blast and were overwhelmed by the falling debris before they could escape. They could not know it (and the knowledge would have given them scant solace), but millenniums later paleontologists were to find their remains and by them date the approximate time of the catastrophe. That day they were but dead camels, buried with a mass of broken vegetation under a welter of fragmented rocks and dust that showered down from a great funnel-like crater. The crater itself was also filled almost to the brim by similar fragments, among which thin streams of lava forced their way upwards toward the surface, cementing the rocks together into a hardened, consolidated mass.

Years passed, millions of years, during which the crater was filled with water-borne debris. The rim was washed away and the whole evidence of the episode was covered by later deposits.

Then came a time when the entire region and many adjoining ones were slowly lifted high above their former level. No longer did the rivers sluggishly flow into the basin, carrying their small loads of sand and depositing them in its lakes and swamps. Now the climate was drier, and the streams became intermittent, subject to sudden floods during periods of heavy rain. They flowed away from the basin, towards the lower lands off the plateau, gouging deep canyons and cutting back into the basin. The soft, river-laid sediments were mostly washed away. In





Drawings by John Bowen

FIVE MILLION YEARS AGO

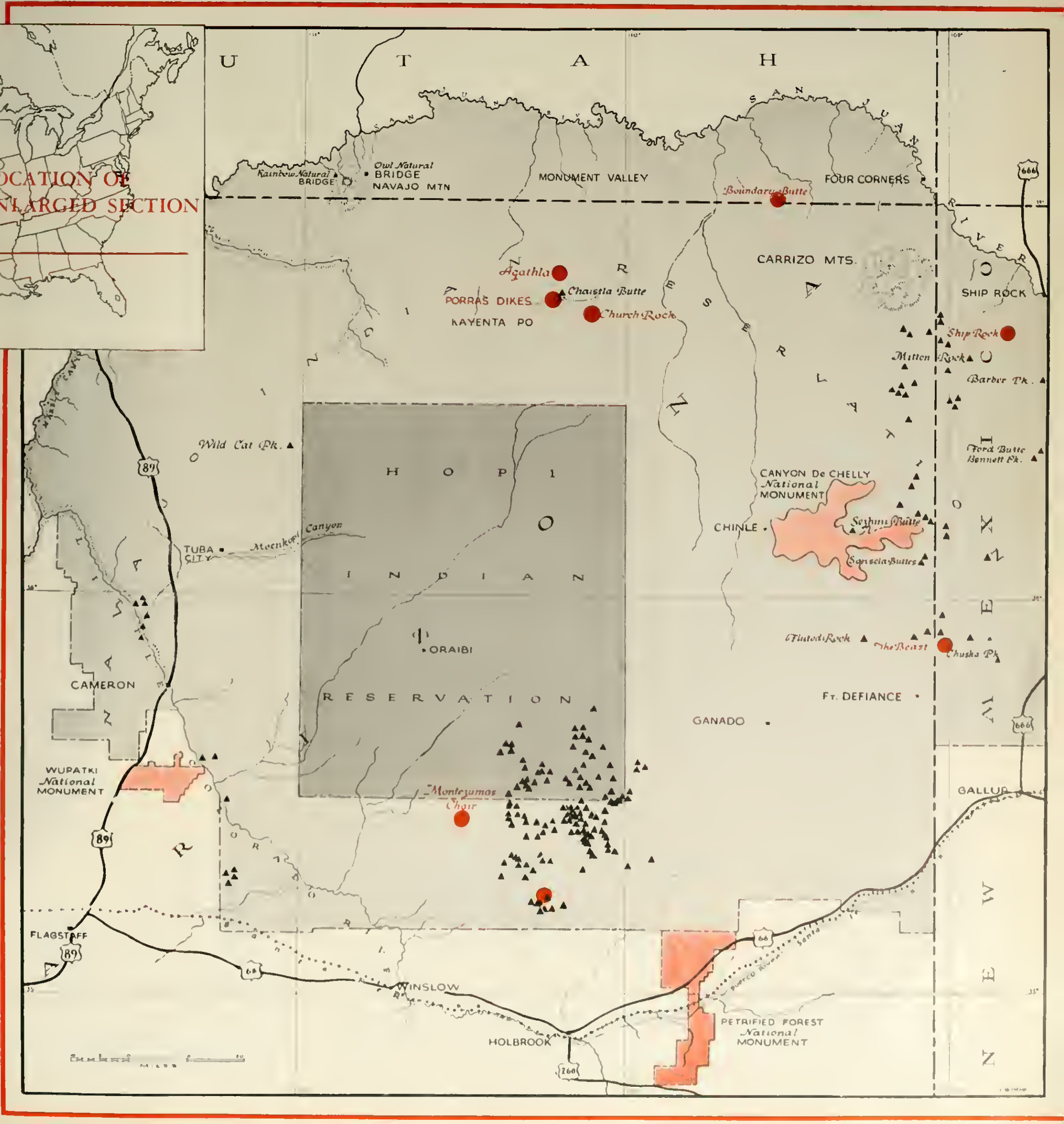
A violent explosion rent the mild and verdant land. Fragmented rocks showered over the surrounding area and its inhabitants. Similar fragments also lodged in the volcanic throat, where they were cemented in place by lava

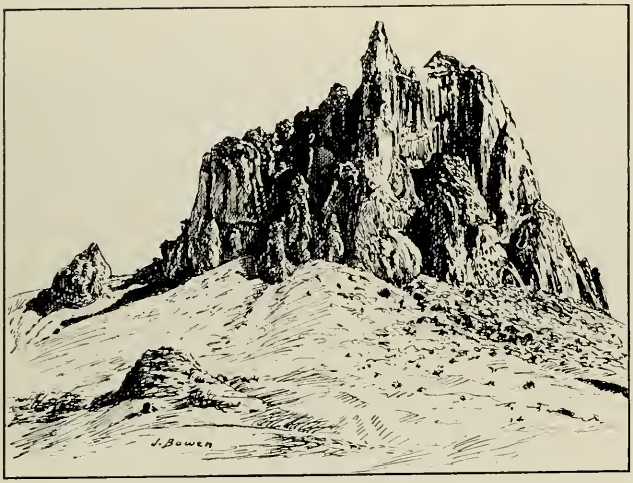
TODAY

Shiprock as we know it stands in a barren plain, for the climate has changed. The softer material round about the hard volcanic neck was weathered away, leaving an imposing tower of rock to remind us of this distant event

(Left) A REMARKABLE view of the 1400-foot rock that has been likened to a ship under full sail. The dark wall of rock extending out from the base is a "dike." This resulted when the earth was fractured by the volcanic explosion. The intruded lava resisted later erosion

THE EXTENT of the volcanic activity which produced Shiprock is evident from the almost 200 other volcanic necks marked on the map below as triangles. Secondary roads passable in good weather reach interesting sections. Circles indicate necks illustrated on following spread


LOCATION OF ENLARGED SECTION
UTAH
SAN JUAN
Rainbow Natural Bridge
Owl Natural Bridge
Navajo Mtn
Monument Valley
Four Corners
Boundary Butte
Carrizo Mts.
Agathla
Chaistla Butte
Porras Dikes
Kayenta PO
Church Rock
Navajo Indian Reservation
San Juan River
Ship Rock
Ship Rock
Mitten Rock
Barber Pk.
Ford Butte
Bennett Pk.
Wild Cat Pk.
89
Canyon De Chelly National Monument
Chinle
Sezhini Butte
Santsela Buttes
Tuba City
Moenkopi Canyon
Hopi Indian Reservation
Oraibi
Fluted Rock
The Beast
Chuska Pk.
Ft. Defiance
Ganado
Cameron
Wupatki National Monument
Montezumas Chair
Arizona
New Mexico
666
Gallup
Flagstaff
66
Winslow
Holbrook
260
Petrified Forest National Monument
Puerco River
Santa Fe
Miles



The two best known volcanic necks in this region are Shiprock, 1400 feet high *(above)*, and Agathla, 1200 feet high, illustrated opposite

time, the deposits filling the crater were again exposed, but because they were cemented by lava, they proved to be harder than the surrounding rock, more resistant to erosion. And thus came into being one of the spectacular sights of our Southwest. The surrounding material was worn away, and the rock that once lodged in the throat of a volcano was left standing as a massive spire on the surface of a flat desert, —Shiprock, a landmark to modern tourists as it was to the early pioneers.

The first inhabitants who came into this region left only their arrow points. Then came the Indians who built their homes on the tops of the mesas and under the overhanging ledges along their sides and on the walls of canyons. Last came the white man, and his scientists, to whom we are indebted for the story of the events of that day five million years ago.

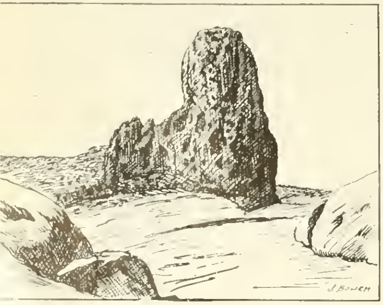
And just what does the record show? As the geologist studies Shiprock, he sees a tower rising about 1400 feet above the surrounding plain. It is more than one-quarter of a mile in diameter at the base, and from it radiate several narrow walls of volcanic rock, known to the geologist as "dikes." One of them, which is about ten feet in width, extends southward for a distance of more than two miles.

The rock itself is composed of angular fragments of sandstone and shale similar to the rocks found all about it. But besides these there are also fragments of limestone and granite, rocks which do not occur anywhere within the immediate vicinity and are, in fact, only exposed many miles distant. These give the geologist a significant clue to the origin of the Shiprock. A study of the rock sequence in the region shows that the nearest limestone is actually found about one-half mile *below* the present surface, and the granites are even farther down. In other words, the presence of these rocks and the fragmental character of all the rocks, plus the small amounts of lava permeating the whole, tell the trained observer that he is dealing with a mass which must have been forced up from below. And the nature and size of the fragments indicate that the force which brought them up was of explosive violence.

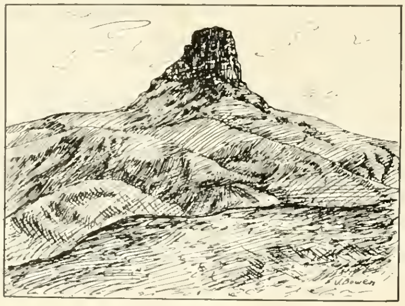
Now, the geologist knows that such forces of explosive violence are the earmarks of one type of volcanic activity. He recognizes two general types of eruption. In one, which he sometimes calls the "quiet" type, the lava slowly forces itself upwards, developing a crater from which it will at times flow out over the country and roll along until it finally becomes too cool to move farther. This type is destructive only in the path of the flow. The other type,

The Beast

All Drawings by John Bowen



Montezuma's Chair



Church Rock

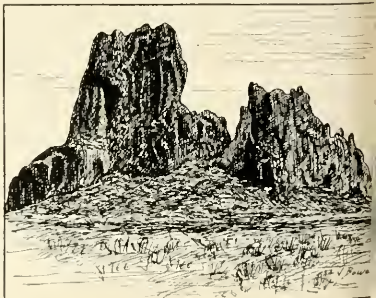
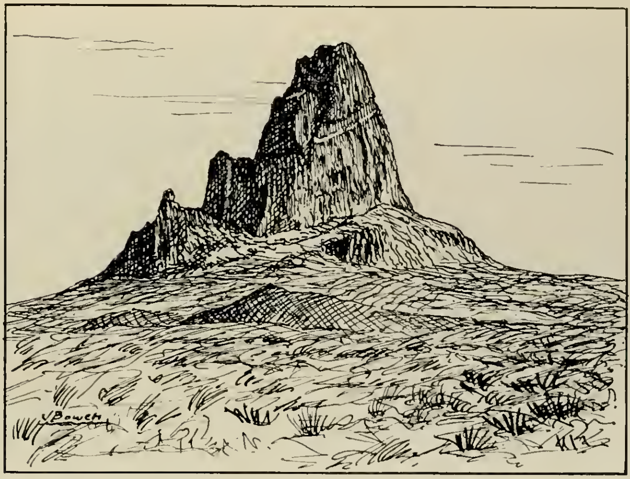


Photo by R. T. Bird



Agathla, at the entrance to Monument Valley in northern Arizona, is also shown in the photograph at the left

which he calls the "explosive" type, is one in which entrapped gasses, mostly steam, build up tremendous pressures below the surface of the earth, which eventually become so great that the overlying rocks rupture with sudden force. A terrific explosion generally results. Most of the destructive, death-dealing eruptions have been of this type. One of them was Krakatoa, in the Netherlands East Indies, which in 1883 blew rock dust seventeen miles into the air and created tidal waves that killed more than 36,000 people in near-by areas. The eruption of Mount Vesuvius that devastated Pompeii and Herculaneum was also of the explosive type.

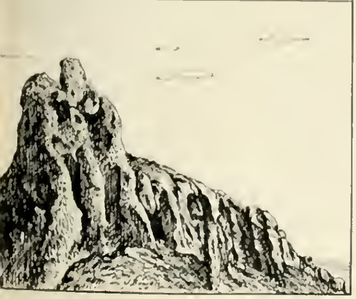
To be sure, the geologist recognizes that the explosive eruption which formed Shiprock was not on a scale of violence to be compared with those mentioned above, but the evidence is clear that the volcanic activity was fundamentally of the same type. The story, as he reconstructs it, indicates that some distance below the pleasant landscape of that day, about five million years ago, there was a great area of very hot rocks under considerable pressure. He is inclined to believe that the surface water, seeping down through the overlying rocks, became highly heated and eventually built up the tremendous pressure necessary to "drill" out an explosion pipe to the surface. The rock occupying the vent was blown out in fragments.

The explosion was so violent that the land around the vent was torn with great fractures; and the hot rocks, becoming molten as soon as the pressure on them was released, rose up the conduit and flowed between the rock fragments, cementing them together. It also filled the fractures radiating out from the vent and solidified to form the dikes.

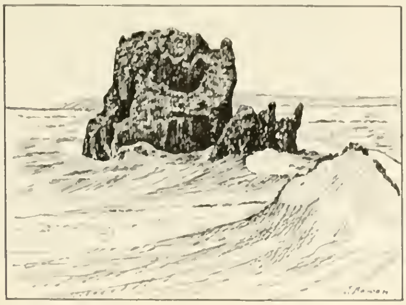
Such is the story of the origin of Shiprock, a "volcanic neck" familiar to many in what is now the northeastern corner of the state of New Mexico.

A great many similar volcanic spines in the same region and in adjacent areas of Arizona and Utah give conclusive evidence that the story of Shiprock is not unique in that region. Although Shiprock is the largest and best known of these "necks," the many others testify to the wide extent of this geologic event. They prove that this "four corners" region, where Utah, Colorado, Arizona, and New Mexico meet, and where the Navahos and Hopis today have their reservation in a land that is hot, dry, forbidding, but extremely picturesque, was once a warm, moist Eden, poised above a hell of hot rocks, whose towering remnants mark one of the largest volcanic fields in our country.

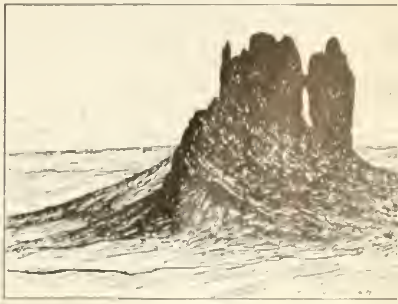
Porras Dikes



A nameless butte, near Holbrook



Boundary Butte



MANGANESE

By FREDERICK H. POUGH
Associate Curator (in charge), Geology and Mineralogy,
The American Museum of Natural History

The ore is here but difficult to obtain—the quality of our steel depends on its production

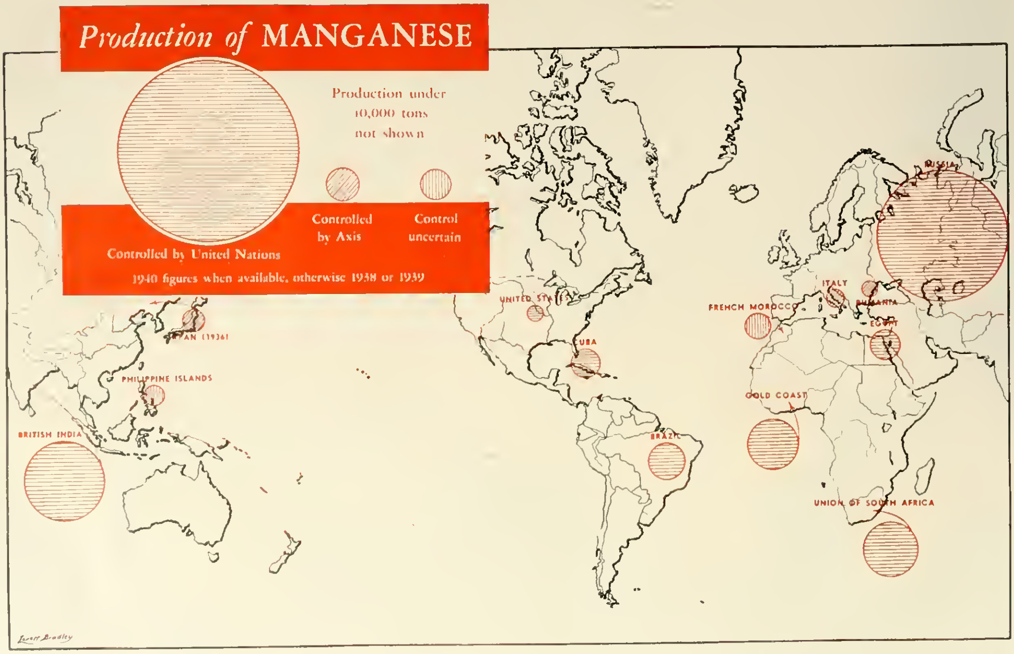
NUMBER four in our series, and Number One on the official list of strategic metals is manganese. There are several simple reasons why it is important. About fourteen pounds of manganese are essential to the production of every single ton of steel, and our own manganese supplies are very limited. It is used in larger tonnages than any other strategic metal, for steel, steel, and more steel is the watchword of modern warfare. Yet no good substitute has been found.

Strategic materials may be divided into two classes: those which can be obtained from our own resources, if a sufficiently high price is offered; and those which are completely unobtainable within our borders, no matter what the price. Our first mineral, tin, for example, is a case of the unattainable. We could not fill our own tin needs if we offered all the gold at Fort Knox. There just aren't any large deposits of tin in the United States.

Chromium and manganese belong to the first class, which includes minerals we can produce in sufficient quantity for some of our needs over a long period of time, and for all of our needs over a very short, but critical, period. These deposits are usually too expensive to operate in competition with imported ores. It is a popular misconception that private enterprise has been remiss in neglecting its opportunity to develop natural resources of the West in times of peace. Nothing could be further from the truth. It is regrettable that in these times an attempt should be made to delude American citizens into believing that private enterprise and private capital have selfishly imported ores which could have been produced at home.

We may take last month's chromite as a case in point. Supposing our deposits had been worked, every chromium product would have cost much more. But more serious than this is the necessity of having a supply in critical times. Mineral deposits are not inexhaustible, every mine reaches its bottom, every vein its end. Supposing capital had foolishly exploited our deposits in times of peace. Where, now, would we fill our needs, which will be so urgent in the next few years? So urgent are they that we are not considering the cost and the waste involved in getting what we *must* have. Our deposits would have been frittered away on cocktail shakers and radiator grills, we should have none to draw upon in the most critical stage in our country's history. Intelligent early planning might have built up a stock pile to carry us for several years, but why not more sensibly leave it in the ground for this emergency?

With manganese the situation is a little different, for we need not worry about a rapid exhaustion of all our manganese resources. It has been recently estimated that one deposit alone, in South Dakota, could supply our manganese needs for many years, since it contains 100,000,000 tons of manganese in sixteen per cent ore. In the past year, the Bureau of Mines examined over 500 occurrences of manganese and ran tests on 135 sam-



STRATEGIC METALS

NUMBER IV

ples from deposits within the United States. Ore was produced from 23 of the 48 states in 1940. So we see that manganese is present with considerable frequency in this country, and can be obtained,—for a price.

Manganese is essential to our war construction program because it is used in such large quantities in the manufacture of steel. Its role is in large measure one of purification (through elimination of sulphur). A manganese-iron alloy known as ferromanganese, which may contain 78 per cent of manganese, or more recently silicomanganese, is added to the molten steel of the open hearth furnace. A reaction takes place by which sulphur combines with the manganese, and oxygen with the silicon. If a stronger finished steel is required, more carbon and some additional manganese are added in carefully calculated amounts.

Spiegeleisen (German "mirror-iron," from its smooth fracture surfaces and white color) is a compound containing iron and manganese in low quantities and much carbon. When added to steel, it reduces Bessemer temperatures sufficiently for ingot casting and adds the necessary carbon for hardness. At the same time, it removes impurities in the form of a slag.

Thus we see that manganese is a necessary ingredient of all steels to improve their workability. The platy iron sulphide, which would form if no manganese were added, would cause the ingots to crack, even at red heat, in the rolling. By converting the potential iron sulphide to nodular manganese sulphide, this danger is eliminated, and the steel is left in a workable condition. Most steels contain only about a quarter of one per cent of manganese, though shell steels may have one and one-half per cent.

Black knobby wad and psilomelane bear little resemblance to the rose-colored rhodochrosite crystal, but all are ores of manganese

AMNH photo by Charles H. Coles

Only about five per cent of industrial manganese is used chemically, the most important chemical use being in dry cell batteries. Small amounts are used in glass and enamel, pigments, dyes, and fertilizers, and in paint and varnish driers. As has been usual with our strategic materials so far, the important uses are metallurgical.

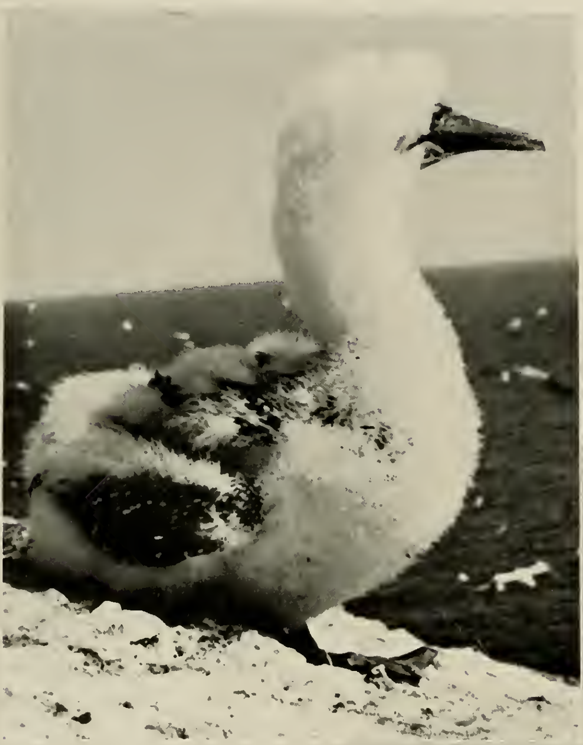
There are several ores of manganese, most of them, from a mineralogical standpoint, rather variable in composition and certainly unattractive in appearance. One compound of manganese, the least important, is the mineral rhodochrosite, a carbonate. This often forms beautiful rhombohedral rose-colored crystals. A fine specimen of this mineral is desirable for a collection, because of its beauty. Really good examples are rare. This mineral is not plentiful enough to be mined for industrial purposes in many places, but at Butte, Montana, it occurs in abundance in more or less close association with many other valuable ores. The first step in its preparation for use is a roasting process which drives off carbon dioxide and leaves a simple oxide, practically the same in composition as the other ore minerals.

There are many compounds of manganese. It is a relatively abundant element and, unlike some of our other elements such as tin, tungsten, and chromium, it is a constituent of many minerals. There are well over 100 manganese-containing minerals, minerals in which it is an essential constituent, and many times that number in which it is present as an impurity. Manganese is often present in small quantities in calcite, a carbonate of calcium. Small percentages in the calcite from Franklin, New Jersey, seem to cause its wonderful red fluorescence; but larger percentages cause the calcite to lose its fluorescent property.

The ores of manganese, aside from rhodochrosite, are all oxides. Most of

Continued on page 23[illegible]

FEATHERED FISHERMEN OF BONA



(Left) THE YOUNG GANNET IN MID-AUGUST. Its body is still covered with down and pinfeathers. These are slowly replaced by dark pinions which mark the one-year-old gannet. After three years of growth, the bird resembles its parent in every detail

PHOTOS BY THE AUTHOR

(Below) THE LITTLE FISHING VILLAGE of Percé, with Bonaventure Island, most accessible of the bird islands, on the horizon. The massive rock projecting from the water is Percé Rock, "the pierced rock," so named for natural archways carved into it by the sea. The village of Percé is a focal point in touring the picturesque coast of the Gaspé Peninsula

NTURE

By
JOSEPH
GORDON

THE TERRACED CONGLOMERATE LEDGES of Bonaventure Island are closely crowded with nesting gannets. The cliffs are several hundred feet high, and the latest tally puts the number of birds at 7000 pairs, not counting the young

A high point in a trip to historic Gaspé, famous since the days of Jacques Cartier, is a visit to Bonaventure, near whose teeming cliffs the dive-bombers of the gannet world wage lively warfare on the life beneath the wave

THE sky is a melee of flying projectiles, the sea a Dunkerque in miniature. Myriad feathered bodies swoop, gyrate, whirl, and dive-bomb. The plummeting meteors plunge into azure billows, dotting the sun-flecked surface with little geysers of spray. Harsh metallic screams and the intermittent splash of falling bodies resound upon the peaceful atmosphere. Below the surface meanwhile, slate-gray shadows zigzag swiftly, endeavoring with every effort to escape the inevitable. The battle is to death—and only the fit survive!

(Below) PARENT AND YOUNG. The helpless chick is fed constantly and may become even heavier than the adult. At four months, the young is deserted by its parents and is forced to leave its cliff home on untried wings and fare for itself

The scene of this stirring contest—the eternal battle for existence—is the chill waters of the Bay of Chaleur in the Gulf of Saint Lawrence, not far from the protruding mass of conglomerate rock known as Bonaventure Island. The contestants are graceful sharp-eyed gannets and torpedo-like streamlined herring. Both creatures are perfectly adapted to their individual environments; but while the fish is eternally bound to live and die beneath the waves, the bird has some mastery over both air and water.

Success is to the quick. Swiftly do the heavy birds seize their prey and wing their way toward the rocky terraces of Bonaventure to the nesting young. Hundreds of birds, heavy-laden in stomach and beak, fill the air. A constant stream comes and goes. The island becomes a scene of moving beauty. Countless birds hover and glide above still greater numbers nesting on the gleaming red rock ledges below. Here is a patriotic symphony of color—red of rock, white of bird, and blue of water.

Bonaventure—"the island of the good adventure." Never was island more aptly named for the enterprising biologist. Yet the thought of ornithological study was perhaps the furthest thing from the mind of its discoverer. It is believed that the first white men whose eyes beheld this island were interested in ichthyological pursuits. Many historians are of the opinion that early fishermen, perhaps Vikings or other Europeans, first scanned the island in the course of their hazardous occupation of reaping from the sea. There are some who hold to the belief that the Normans and the Basques, in the darksome days before Columbus, traversed the stormy waters of the North Atlantic to fish for cod and herring and perhaps to trade with the Indians.

One of the apocryphal stories concerns one Thomas Aubert who sailed up the St. Lawrence in the early part of the sixteenth century on a voyage of discovery. He is supposed to have reached the village of Tadoussac, where he convinced the Indians of his friendly motives and then made off with one of them to dis-

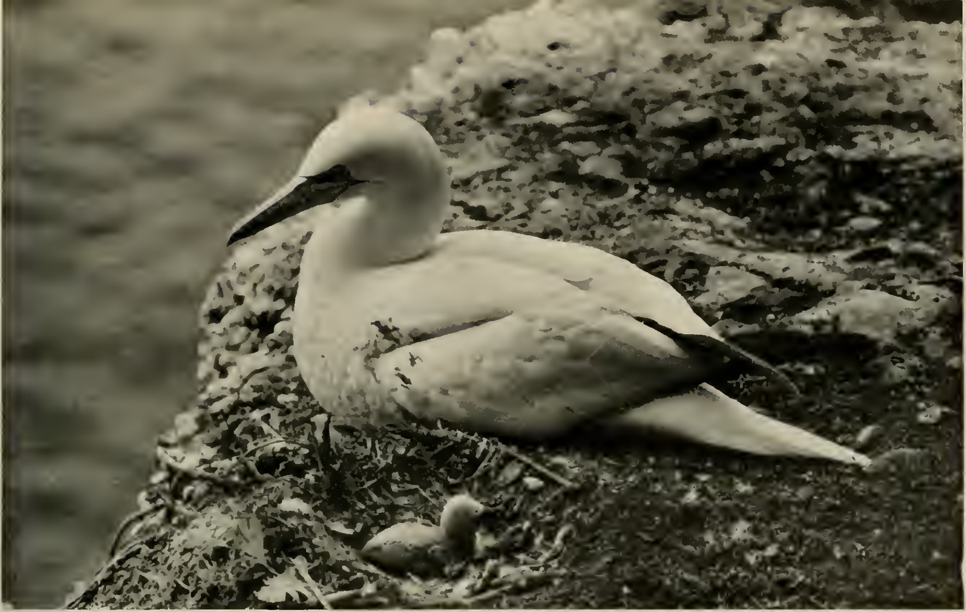
Photos by F. H. Fleischmann

play upon his return to France. Velasco, a Spaniard, is supposed to have explored eastern Canada in the year 1506. But on a map of 1520, drawn by a Portuguese cartographer, the name Breton appears, which lends credence to the thought that the fishermen of Brittany first saw these shores. Much is conjectural, however, concerning the activities of these intrepid seafarers, for none left written records or telltale remains upon the newly discovered shores.

Doughty Jacques Cartier, a Breton, is accredited with the discovery of the St. Lawrence and the Bay of Chaleur in July, 1534. His expedition was commissioned by Francis I of France, who thought to establish some foothold in the New World, along with the Spaniards and Portuguese. Leaving Saint-Malo April 20, 1534, black-bearded Cartier set the bow of his sturdy wooden craft toward the west and the Unknown. After almost a month of steady sailing, the coast of Newfoundland was raised. Sight of land, however, was short-lived, for a severe storm arose, and Cartier ran before the gale. He skirted Prince Edward Island and on the eighth day of July put into the Bay of Chaleur. Sailing up the bay, which he assumed to be the mouth of some great river, he soon realized his mistake and put ashore where the village of Gaspé now stands. Accompanied by his men and a few local Indians, he commanded a giant cross, 30 feet high and adorned with the Fleur-de-Lis, to be erected upon the spot. The surrounding land and all its environs were thereupon taken in the name of His Majesty, the King of France.

Cartier's chronicler, according to Hakluyt's translation, says that the great bird-islands in the mouth of the St. Lawrence were "as full of birds as any medow is of grasse, . . . and in the greatest of them there was a great and infinite number of those that wee call Margaulx, that are white, and bigger than any geese." Bonaventure itself is apparently not referred to here, but rather the so-called Bird Rocks in the mouth of the St. Lawrence.

Between 1860 and 1887, the population of the Bird Rocks fell from 150,000 gannets to an estimated 10,000. Local fishermen were killing the birds off in large numbers. Gannet flesh was considered good fish bait, and fresh eggs made very good eating. One of the ingenious methods for reducing the feathered population was to tow behind one's boat a board upon which a herring was painted. The bird, spotting the lure, would dive head on for the cap-



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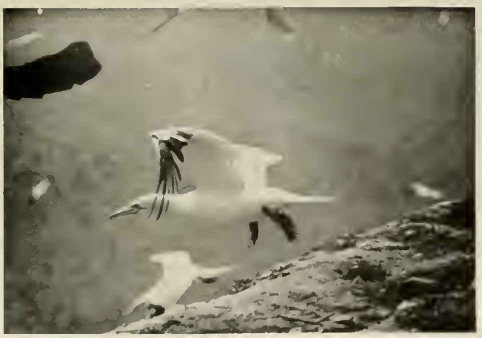

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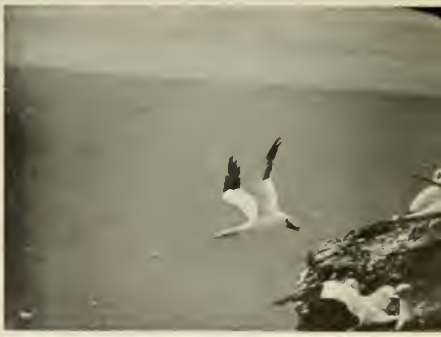


6

1. TAKING OFF: an action photograph which catches the gannet in a posture of rare beauty

2-3-4. These photographs show the wing action of this master of flight during the first few strokes of the take-off

5. A comparison between the adult and the recently hatched chick. The chick may even exceed the parent in size before the latter deserts it at the brink of its aerial existence

6. When landing at the nest, the slightest miscalculation on the part of the parent may shove the helpless infant to sudden death on the rocks below

ture, hit the wooden drag, and break its neck. All this took place before 1919, for in that year the Canadian Government realized that the gannet, as well as many other shore and pelagic birds, was slowly headed for extinction. A Migratory Birds Convention Act was passed, and Bonaventure along with the other bird-islands became a Federal Provincial Bird Sanctuary, watched over by a guardian appointed by the government. Consequently the colony on Bonaventure has increased, and today between 7000 and 10,000 pairs of birds are estimated to make their homes on its rocky ledges during the summer. The conglomerate terraces also accommodate numerous kittiwakes, murres, puffins, razor-billed auks, petrels, and sea pigeons.

Eight Canadian families live upon the small island, deriving their livelihood from fishing, farming, and American tourists, whom they sail around the island for a small fee to view the inspiring sight of thousands of nesting birds. These inhabitants are of English and French descent and represent the last few members of a once-thriving fishing village. The younger members of the families often find it thrilling to clamber up and down the precipitous ledges hunting for stray sheep that have answered the call of their ancestors to go skipping about the narrow and hazardous trails.

The gannets arrive at the nesting ledges on Bonaventure in the latter part of March and throughout the month of April. In these northern latitudes the snow may not yet be gone. They immediately construct crude open nests of seaweed, other marine plants, dirt, straw, and moss. This mass is all matted and caked together with excrement, remains of fish, and slime. A slight concavity is left, and in this the female deposits a pale-blue, chalky egg, much soiled in appearance, and about the size of a duck egg. Occasionally two eggs may be seen in one nest, and it is believed that the second was laid by another female.

From about the middle of May, when the egg is deposited in the crude nest, until the end of June, the parents alternate in brooding the egg. Most of the "labor of love" is relegated by the more adventurous male to the home-loving female. Then comes the red-letter day when the young breaks forth from the limy prison walls to grace the crowded cliffs with its excessively ugly and helpless presence. Black-skinned, naked, and shapeless, it lies prostrate in the nest with eyes closed, zealously guarded by both parents. Within a week the white down begins to grow, the eyes open, and the helpless nestling begins to resemble somewhat its forebears. The young bird's manner of obtaining food is a trait showing definite relationship to the pelicans and cormorants. Instinctively, the young thrusts its head into the gaping mouth of the parent and with its slender beak partakes of the partly digested fish which the parent produces. The parent is able to perform this feat by virtue of a slender strip of elastic membrane extending down the throat.

The young bird gorges itself and before long has assimilated so much food that it exceeds its parent in weight and size, becoming an awkward, fluffy figure. During this period both parents must be extremely cautious in landing and taking off. The slightest miscalculation may accidentally shove the helpless infant from its insecure perch to sudden death on the rocks below. Upon returning to the nest after a foraging expedition, the parents may indulge in a bit of affection by rubbing bills. The actions simulate friendly swordplay, but at the same time definitely show signs of deep attachment between the birds. Sometimes the male may bring his mate a bit of seaweed or some other marine trinket as a gift, no doubt excusing himself for his lateness in returning home.

From June through September the helpless fledgling grows. Its fluffy down is replaced slowly by a sooty brown plumage dotted with white. Its immature wings shape out with constant flexing and extending. Then at last the young is old enough to shift for himself, and the parents desert the nest. Answering the call of hunger, the fledgling takes off with justified hesitation on untried wings and does not return to Bonaventure for up to three years.

Away from home and leading a strictly seafaring life, the young gannet molts and exchanges its darker plumes for white, so that at the end of two years the head and underparts are white and the back is dark. By the completion of the third year of growth the bird has been transformed into a golden-headed beauty, graceful as only the gliding birds can be. The wing tips are margined with funereal black, but the abundance of white gives the bird the liveliness of an airy snowflake dancing on a breeze. Its legs are webbed with heavy flaps of tissue which help both in landing upon a selected spot and in taking off from the surface of the water. Its eyes, rimmed with modernistic spectacles, are keen of sight and especially adapted for following the prey through the water after the shocking plunge.

The mature bird is a miracle and a wonder machine from the planning boards of Nature's laboratory. To see it winging overhead in measured beats, to view it diving from a height of 75 or 100 feet in a spectacular descent on partly folded wings, to observe its peculiar customs, its greetings and squabbles on the cliff, to think of the mother-warmth of the female in refusing to leave its young in peril, is sufficient reason to cause man to cogitate with deep meditation upon the infinite variety of Nature's handiwork.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Spring, 1942.

SUNDAYS over the Mutual Broadcasting System from 9:30 to 10:00 A. M.

This Wonderful World. Quiz program, with young people answering questions on nature subjects.

WEDNESDAY over the Columbia Broadcasting System Network from 9:15 to 9:45 A. M. (Central Time: 2:30 to 2:55 P. M.; Mountain Time: 9:30 to 10:00 A. M.; Pacific Time: 1:30 to 2:00 P. M.)

Lands of New World Neighbors. (New Horizons: C.B.S. School of the Air.) The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

WEDNESDAY, April 8, over WNYC from 3:30 to 3:45 P. M.

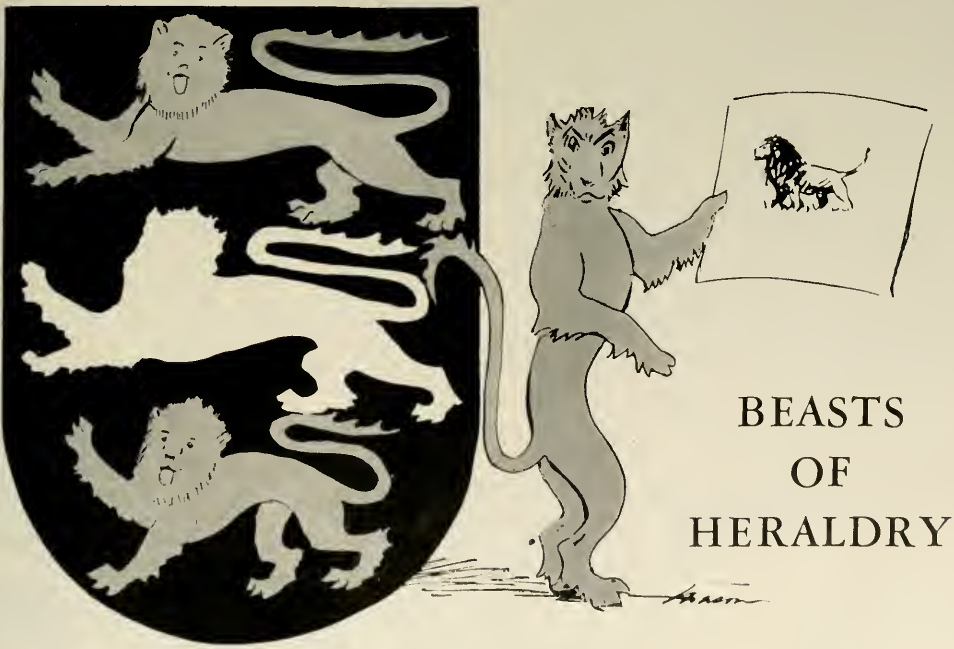
Know Your Museum: "Social Behavior in Animals."

WEDNESDAY, April 22, over WNYC from 3:30 to 3:45 P. M.

Know Your Museum: "The Recording of Bird Calls in the Field."

FRIDAYS over the Columbia Broadcasting System Network from 4:15 to 4:30 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.



BEASTS OF HERALDRY

By JOHN ERIC HILL

Drawn by

G. FREDERICK MASON

IN the Middle Ages the animal most frequently represented on shields and banners was the lion. He was usually rampant, rearing up in anger; he also appeared walking on all fours, springing, crouching; sometimes only his head was depicted. The oldest known armorial seal of a medieval prince bore the Lion of Flanders, which today graces the arms of the sovereigns of Belgium and of the Netherlands. But the three beasts on the English royal arms since the time of the Plantagenets (thirteenth century) were meant to represent leopards, not lions.

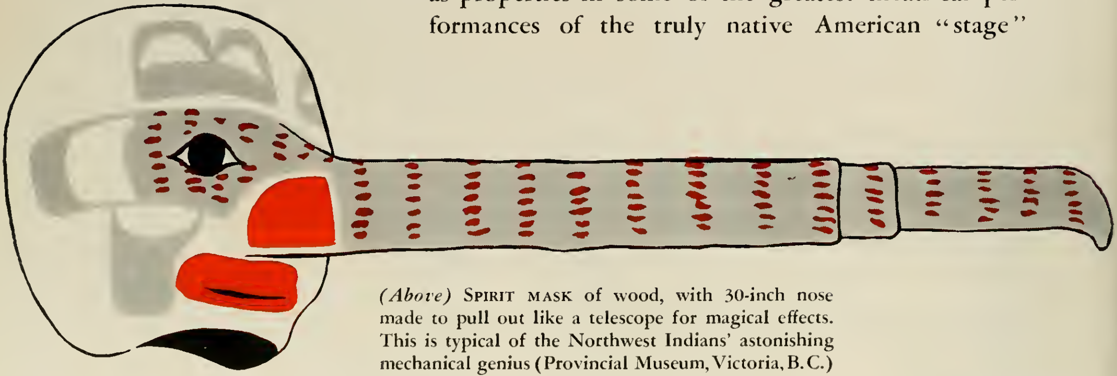
As compared with lions, few leopards appear on the arms of the period, but friend and foe alike wrote of the leopards of England. Henry V's herald was the Leopard Herald. A little over 100 years ago Napoleon's gazettes were referring to the successes and reverses of the English leopards.

The natural history of the days of chivalry was largely hearsay. A tradition then current, for instance, told how the lion had a romance with the pard, or panther, and how the offspring of this irregular union was the leo-pard. ("Leopard" is now the name generally used for the panther itself.) The legendary leopard was not described, but the heralds decided he would look like his father, the lion, but would be smaller. Size is not indicated in armorial bearings. How then would they distinguish the leopard? They decided to make him just like the lion, but as the lion always looked straight ahead or backwards in heraldry, the leopard would be shown fullface.

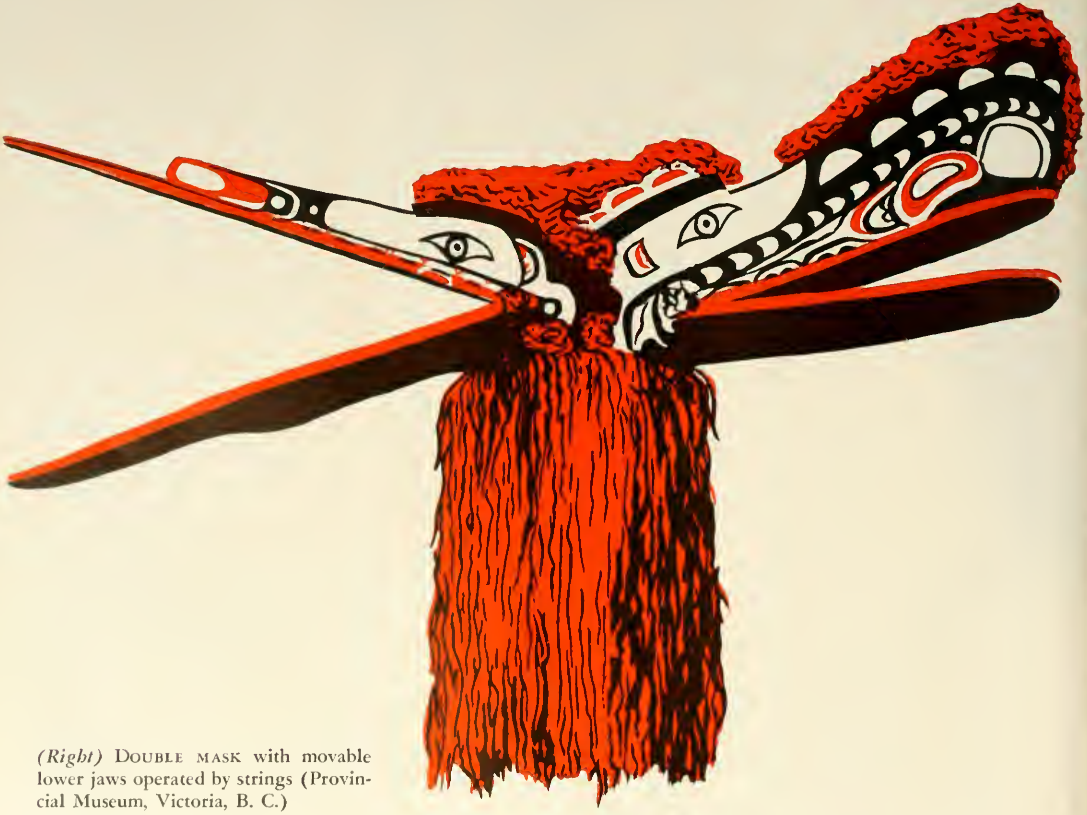
Tigers were very rare. They were represented as having the body of a starved lion and the head of a wolf; or a moustache added to the lion would make him a tiger. Other mammals were rarely used: oxen, antelope, deer, boars, bears, wolves, foxes, dogs, squirrels, and even elephants, occurred on medieval arms. In most cases better representations were made of these animals than of the lion, leopard or tiger; this may have been because the heralds had seen them.

MASKS

These strange expressions of the primitive soul served as properties in some of the greatest theatrical performances of the truly native American "stage"

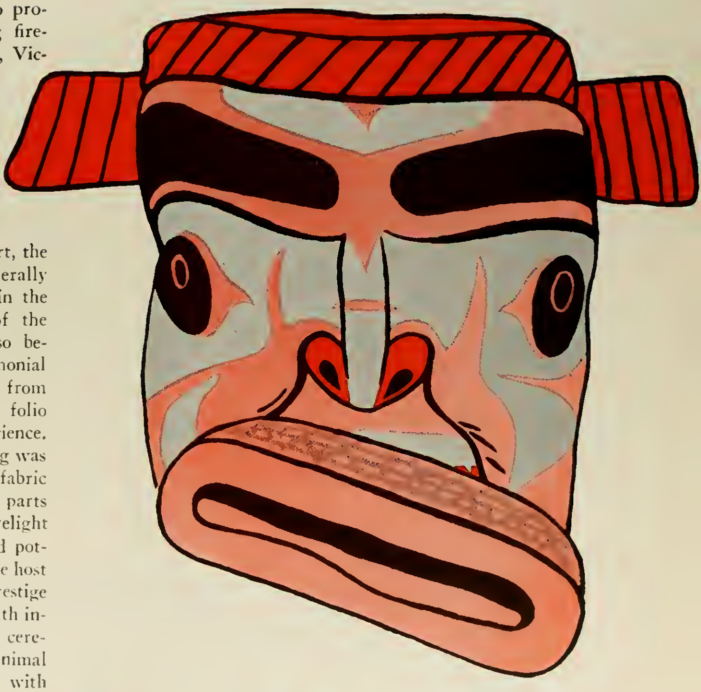


(Above) Spirit mask of wood, with 30-inch nose made to pull out like a telescope for magical effects. This is typical of the Northwest Indians' astonishing mechanical genius (Provincial Museum, Victoria, B.C.)



(Right) Double mask with movable lower jaws operated by strings (Provincial Museum, Victoria, B. C.)

A MASK WITH MOVABLE mouth, designed to produce hair-raising grimaces in the flickering firelight of the ceremonial (Provincial Museum, Victoria, B. C.)

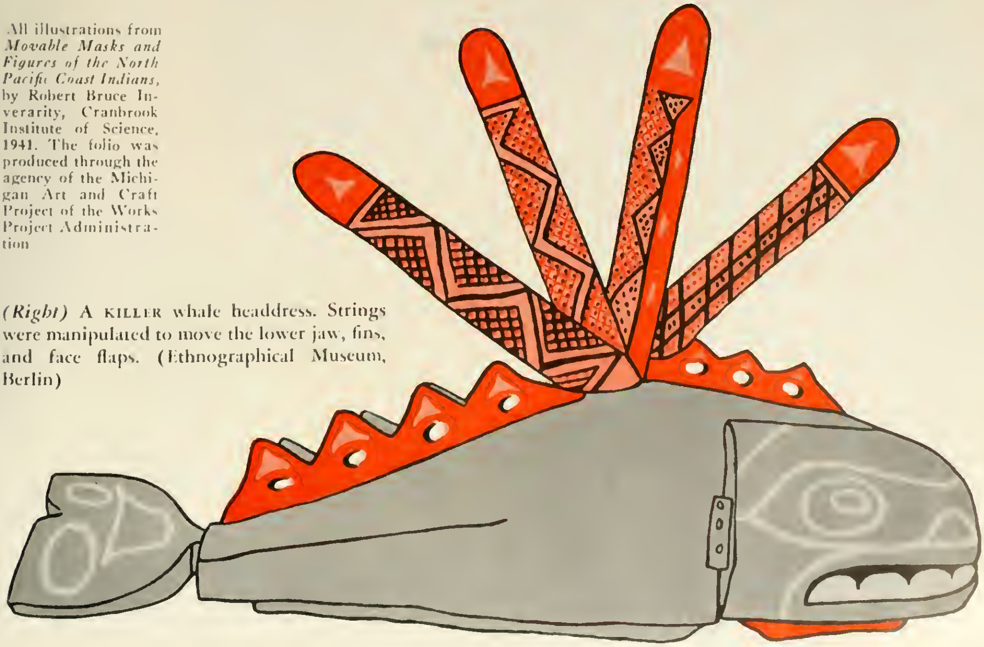


By raising whittling to the level of high art, the Indians of our Pacific Northwest literally carved themselves an immortal niche in the realm of esthetic self-expression. Creators of the spectacular totem pole, these tribes have also bequeathed a wealth of intensely dramatic ceremonial masks. The four examples shown here are taken from the elegant silk-screen reproductions in the folio recently issued by the Cranbrook Institute of Science.

Like most native art, Northwest woodcarving was closely woven into the economic and spiritual fabric of tribal life. Ingeniously wrought movable parts added to the weird effect of spine-tingling firelight dances performed with masks at the celebrated potlatches. The latter were great indoor feasts. The host frequently impoverished himself to gain both prestige and a horde of debtors obligated to feed him with interest when times grew lean. Climax of their ceremonies was the mystical return of ancestral animal spirits in the person of masked actors inspired with absolute belief.

All illustrations from *Movable Masks and Figures of the North Pacific Coast Indians,* by Robert Bruce Inverarity, Cranbrook Institute of Science, 1941. The folio was produced through the agency of the Michigan Art and Craft Project of the Works Project Administration

(Right) A KILLER whale headdress. Strings were manipulated to move the lower jaw, fins, and face flaps. (Ethnographical Museum, Berlin)



SOLE CONTACT with the outer world. Once a week, the "swamp truck" *(above)* transported provisions across a 40-mile cordon of trackless marshland

A lady ethnologist and her two children penetrate Everglade jungles to learn the ancient tribal ways of the unknown Seminoles, an example of what unique adventures await explorers in their task of rediscovering America

WHICHEVER way I turned, curious eyes in coffee-brown faces watched me and were instantly averted. For seven hours now, the Indians had dug and pushed the swamp truck through the 40 miles of trackless wilderness that separated us from the nearest road and civilization.

I was too elated to mind the shy scrutiny of the Indians, for after years of discouragements, I was actually arriving at the goal towards which I had been striving. I would do what no scientist had yet done. I would live among these people in their own environment long enough to be their friend, to share their daily life and see their customs unfold unselfconsciously around me. The truck came to a final halt.

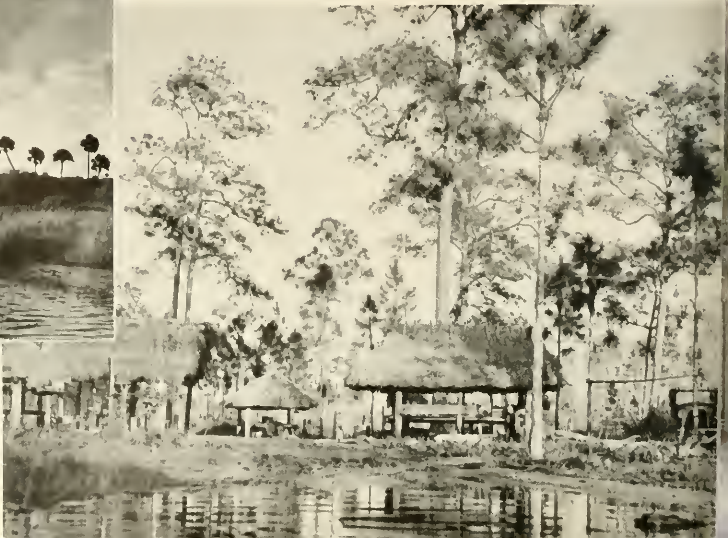
"Your wish is granted," called Mr. W. Stanley Hanson, the government representative in charge, as with a flourish he flung open the gate to the Big Cypress Seminole Reservation, in the heart of the Everglades. And my wish did come true, for the next year I brought my children with me and we took our place in the Indian community as another family, another camp to be visited and other children to be played with.

For a number of years I had been working in anthropology. Because my winter home was in Florida, it was logical that I should center my interest on the near-by Seminole. Dr. Clark Wissler, Curator of Anthropology, approved of my plan, and in 1938 I began my association and research work with the

(Above) ROLLING through Big Cypress country

(Below) NOT SAMOA, but a typical thatch-roofed village in Florida's Seminole reservation. These *chi-kis* afford more privacy than their open walls would indicate. Erected on stilts, their "floor" comes within a foot or two of the overhanging eaves

(Above) THE FAMOUS Tamiami Trail: the only road that cuts across the Everglades and Big Cypress country in an east-to-west direction



(Left) THE "NEW GIRL." Cocky Freeman, 14, found it no harder to break the ice among the Seminoles than in any other new neighborhood

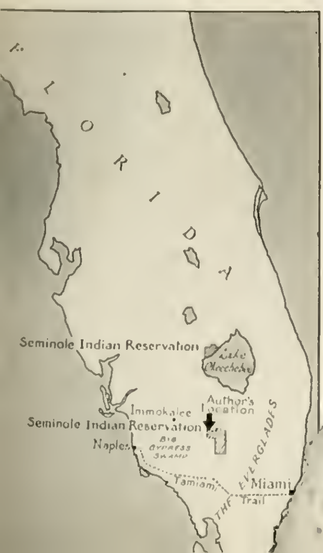
(Right) AUTHOR and Seminole braves. Comradery soon displaced the hostility they felt at first

(Above) TWELVE-year-old Leon Freeman and his Seminole pal, Billy-Buck, at rest on a wild oak

ALL PHOTOS BY THE AUTHOR

We live with the SEMINOLES

By
ETHEL CUTLER
FREEMAN


F L O R I D A
Lake Okeechobee
Seminole Indian Reservation
Immokalee
Author's Location
Seminole Indian Reservation
Naples
Big Cypress Swamp
Tamiami Trail
The Everglades
Miami

American Museum of Natural History in New York, later taking two expeditions to the field for them.

I found a unique situation, a group of practically unknown people living in an unexplored wilderness, in the very midst of our own civilization. These people were the Big Cypress or southern group of the Seminoles. They are among the most unapproachable and least known Indians in the United States. The wild swamp in which they have their palmetto-thatched huts, or *chi-kis,* is impassable for eight months of the year. It is about one-third again as large as the state of Connecticut and, roughly speaking, stretches from sophisticated Palm Beach and the coastal fringe of towns on the east to Key West on the south and Fort Myers on the west. Only one road cuts across this expanse east and west. It was into this morass that the Indians fled when resisting deportation to Oklahoma during the Seminole wars of the 1800's. Now with a belated twinge of conscience, the government has set aside this land for the Seminole's exclusive use.

This limestone saucer, filled with the muck of decayed vegetation, is tipped slightly to the south, where the water brims over. There are no stagnant pools in the Everglades. Within the cypress heads, strangler fig, festoons of wild grape, orchids, tree ferns, and air plants crowd for space where sunlight barely filters through the heavy foliage. Here, water stands knee-deep, and many cottonmouth moccasins make this their home. Their menace was never forgotten by the Seminole as well as the white man. At all times the Indians watch for signs of danger, but in this, as in other things, they are not aggressive. They do not kill the poisonous snakes, but avoid them. I was likely to see several wriggling forms between my tent and the Indian village a hundred yards away. Some of these were cottonmouth moccasins, big fellows five or six feet long. In the cypress heads they were as numerous as eels in a tank.

"Do you know the origin of these Big Cypress people," I asked Mr. Hanson, as I watched the arrowhead-like ripples where snakes swam calmly on their way. I was hoping for local information not found in books. "No, I guess no one does, really, unless the Seminoles know it themselves, but they won't talk. They speak a kind of Mikasuki dialect, and so I figure that they must have come from southern Georgia where the Mikasukis lived." Mr. Hanson looked thoughtfully at one dark-skinned Indian. "Maybe some of these married the Calusas, the fierce Indians who were found in southwest Florida by the Spaniards long ago, but sometimes I suspect that they have many wild strains of blood. Mr. John Collier, Commissioner of Indian Affairs in Washington, said that 'they were gentle but wild,' and he was right."

"What of the Cow-Creeks around Lake Okeechobee?" I asked.

"Oh, they're Creeks and speak Muskogee," he said, uninterested. "We know all about them. The two branches of the Seminole don't mix and don't like each other."

"Is it true that the Big Cypress teach their children that we are beasts and bring evil to them if they so much as look at us?" I persisted, for he was brought up among them as a favored individual and knew their ways. The Seminoles were dear to his heart.

"Why wouldn't they," he countered. "We captured their great warrior, Osceola, under a flag of truce and threw him into prison. We gave a bounty of $500.00 a head for every Seminole brought in alive. Would you like the people who hunted you like animals through the Everglades? The Seminoles are still afraid of the government. They fear spies, for they believe even now that we want to catch and deport them."

"I can't speak their language," I said, looking at the Indians to see whether they seemed suspicious. "How will they know that I want to aid, not harm them?"

"They do misunderstand, often," was his disconcerting reply. "They believed that dead men's spirits hovered around some army blankets that I received, and I could not make them understand that they were new blankets and harmless. They were much excited about it."

As we were crossing the Everglades on my first trip, these strange and ominous attitudes were foremost in my mind, and so it was not surprising that my heart was beating like a trip hammer in anticipation of this adventure. It was to beat even faster before my trip was over. Here I was in the Everglades, out of communication with the outside world. My companions were one white man, many Indians, and a sixteen-year-old Florida girl, who was the only person I could hire to come with me. I had never seen any of these people before the day of my arrival. What lay ahead? Where would I live and what would I cook on? But most important was the doubt: could I make the Indians understand my real friendliness toward them? Could they believe, in spite of their past experiences, that I had no ulterior motives in coming among them? No one had been able to tell me about conditions at the Reservation, for few people had been to this remote spot. We had left the last white people at the outpost town of Immokalee, which means "My Home" in their language.

As we crossed the Everglades, none of the Indians thought of discouragement after hours of grueling work. "Chi-ko-li-set" (Sit down), they would laugh among themselves, as we bounced like popcorn on a hot griddle. Or they would clown about their inability on foot to overtake the crawling truck, joking "Mon-ka-shai" (Wait a minute) as it yielded to their pushing and crept through the mire. Each was still gaily alert to do his share. Already I felt the strength of their indomitable spirit, which overcomes all obstacles not by aggression but by co-operative intelligence. This struck me forcibly, for I was sore and tired from the hard trip when, long after dark, the swamp truck came to a final halt.

I could see the flickerings of eight or nine campfires through the cabbage palms and pines. A typical Seminole village, like a stage setting, stood so close to me that I could almost touch a *chi-ki* with my hand. The central fire under its roof of smoky thatch, illuminated the tropical trees and the clustering *chi-kis.* The women and children in their swaying skirts made splashes of vibrant color as they carried the food to the eating platform for their men, who were just arriving. It was a dramatic picture of a people unspoiled by white contact, still leading their old native life.

The lights of the truck shone on Mr. Hanson's small white bungalow in its neat enclosure. "I've turned the storeroom into a bedroom for you and Delia," he apologized. "I'm afraid that you won't be comfortable, for I have only an upturned orange box for a dressing table."

There were no conveniences in the house. We drew water from the pump under the guava trees in the yard and we cooked supper on a kerosene burner that looked like a chafing dish. "By the way," Mr. Hanson said casually, "you had better hang your clothes over the window, because two Seminole men have volunteered to sleep on the porch, just outside, to be ready in case of need. But we are safe as a church." Mr. Hanson added hastily.

Not without visions of Indian massacres, with the two faithful defending us from the other savages, I got out my bedroll, and Delia and I were soon asleep.

The next morning I awoke with the impression that some bird had called a few feet from me. Wild turkeys had run ahead of us the day before. Ibis, heron, and egrets had risen in great flocks to settle a short distance away. Sand-hill, whooping crane, and limpkin had looked at us from near by, and I wondered which of these birds would make this strange sound. The call was again repeated from several locations. It lingered eerily.

"How did you like your alarm clock?" Mr. Hanson grinned, as we appeared. "Did you think that you heard birds? The Indians were calling to waken you."

Later that morning I was sitting outside the enclosure, where I could see the thatched roofs of seven villages and the bustle of life in those close at hand. I heard again the clear bird-like tones and, looking up, saw a figure coming toward me. Sho-ki,* age fifteen, swung along with his head thrown back and a band of bright beads fastened charioteer-wise around his smoothly oiled hair. He was blowing through cupped hands, using his fingers as though playing a flute. He was signaling to one of the villages, perhaps telling them that I was there. That evening, as Delia and I walked out in the moonlight, a calling was immediately set up between the camps, and dark forms came out toward us. We beat a hasty retreat.

I had read in the old books that the Indians communicated by bird calls when they were attacking during the Seminole wars. When I was wakened in the dark, several mornings later, by peculiar urgent and excited high staccato notes, I was worried. They seemed to be relayed from near to far village, back and forth, and ended in a kind of turkey gobble, as I had been told they always do. The day before I had visited many of the villages for the first time. Did they suspect me? Were they saying, "How will we get rid of the spying woman?" I lay on my cot and listened and held my breath. After half an hour the bird notes ended. Later I found that one of their tribe had been arrested for drunkenness and was in jail. Presumably they were spreading this news; but I do not know their method, nor does anyone else, I believe.

The first morning after my arrival I wanted to meet the Seminoles who had just wakened us in so novel a fashion, and I followed Mr. Hanson out after breakfast. The Indians were coming into the enclosure, and I said 'Hon-tam-o" (How do you do), as they walked by. Though a white woman in the Everglades was an unusual sight, they passed me without a glance. A young woman came in with her baby astride her hip. "Hi-li-ga y-a-to-si" (A healthy fat baby), I ventured, reaching for the infants' hand. But the child clung to its mother in fear, and the woman turned her back on me abruptly and walked quickly away.

Mr. Hanson beckoned me to join the group who had ignored me so completely and introduced each to me by name. Every man looked me directly in the eye as though trying to read my inmost thoughts, and shook hands solemnly. The woman and child now sauntered over, and her husband spoke to her in Seminole. She turned around, looking at me shyly, smiling. I was accepted by them, because their white friend vouched for me. This was the beginning of my friendship with the Seminoles, thanks to Mr. Hanson, the only white man who has their love and confidence.

I felt that I was just beginning to get beneath the surface of the lives of the Indians on the Reservation and the Tamiami Trail during my first visit of five weeks that winter.

That year of 1939 was the period of the great fires in southern Florida. I was not there at the time, but the papers all carried reports of barren, blackened stretches, where fires had raged, and animals and birds had been driven 200 miles north from their regular haunts beyond the Everglades and Big Cypress swamps, to the far side of Lake Okeechobee. What had become of the Seminoles who lived in this area? Had their camps been burned? None of the accounts mentioned them. How did they feel toward the white man, who by drainage of their land had now added another tragedy to their lives? All of these things I wanted to know. It also seemed important to consolidate the friendship that had been begun between us, before they had forgotten me. So in April I returned for a happy and profitable month, finding that few of the villages had been damaged, and none seriously.

In February, 1940, I believed it feasible to bring with me my daughter Cocky and son Leon Jr., age fourteen and twelve respectively,—if snakeproof leggings and antivenin were part of our equipment. A tutor solved the school problem, but the firsthand contact with people of different and often more idealistic and unselfish values than our own was to teach us more than we could learn from books.

Again we had arrived long after dark, in the rain; and towards midnight our five tents were battered by the tail end of a hurricane. I would have been happier had I known that the Indians, used to storms, had cut down good-sized cypress trees and had placed them, like their *chi-ki* posts, four feet in the ground so that our tent ropes would be secure. The smell of coffee and sizzling bacon the next morning was comforting.

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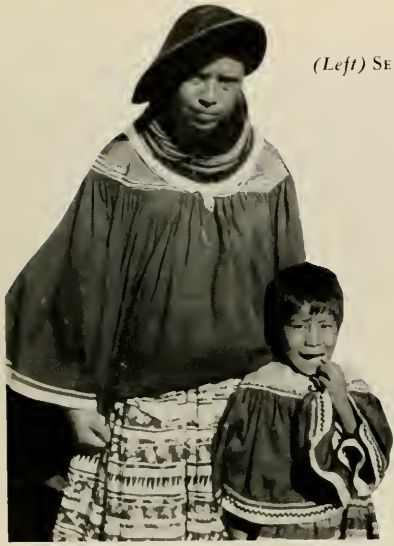
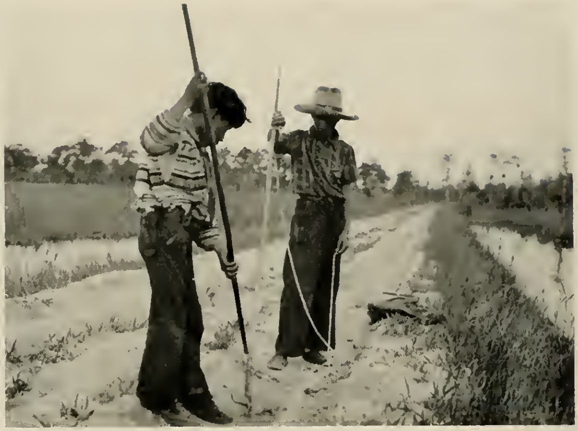
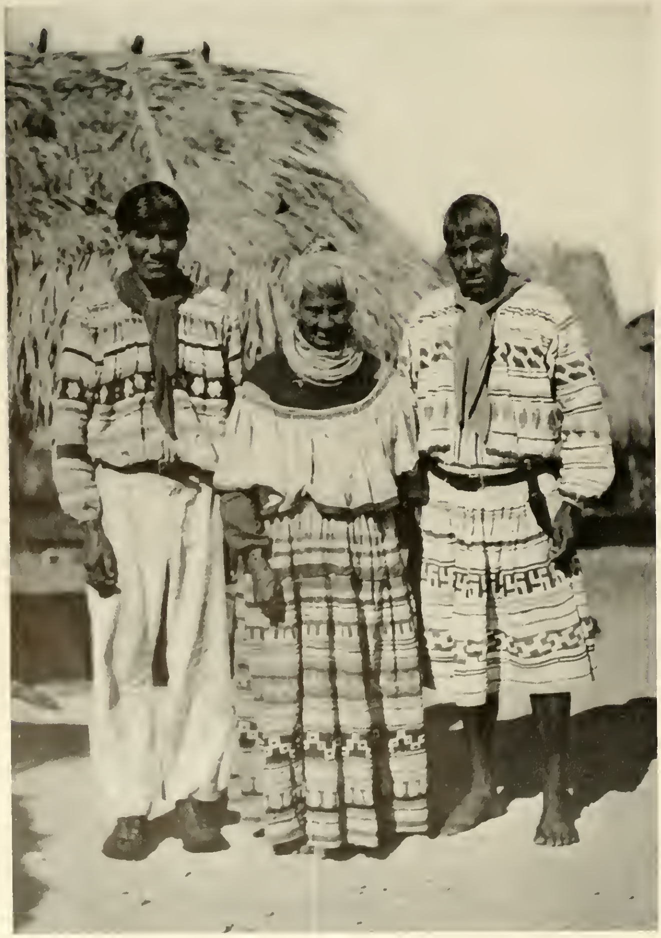
*The Indian characters have true Seminole names, although they are not their own



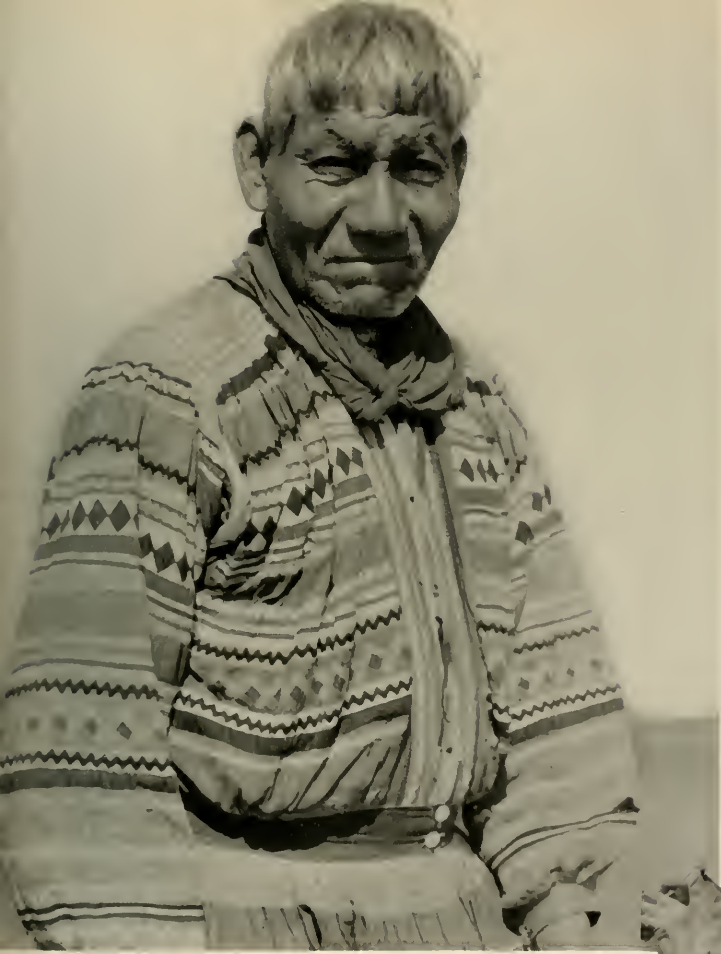
(Left) Seminoles call on us



(Above) Spearing nonpoisonous snakes. Billy-Buster, in the foreground, lunges with lightning speed, while Leon Freeman tries to learn the knack. Billy never missed. After the snake was killed he made a curious ritual of washing his hands for several minutes

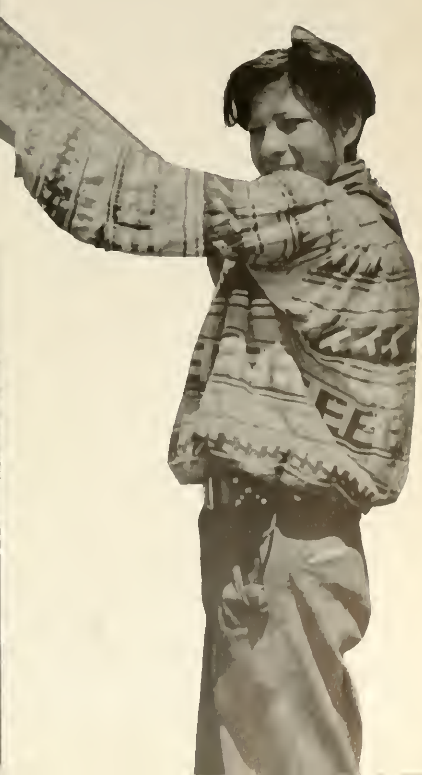


Three generations of Seminole fashion *(left)*. "Old Woman" is over 100 years old and wears the dress and hair style of her youth. The man at right is of her children's generation, the one at left, of her grandchildren's

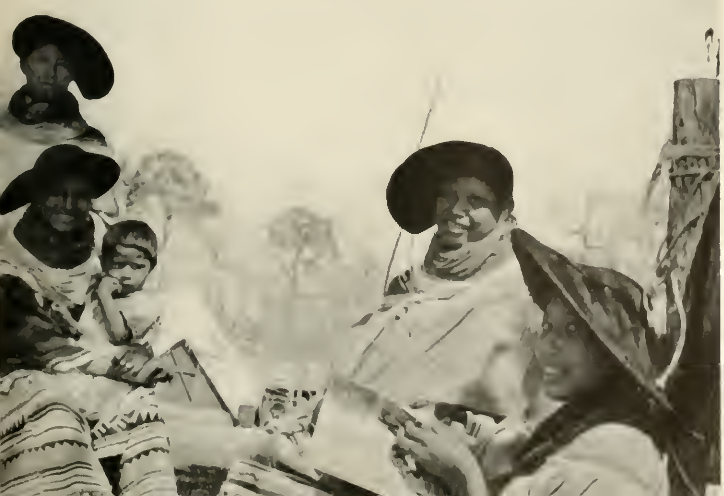


This old man's dress is made in one piece and belted at the waist like a Russian tunic. It hangs to slightly below the knees

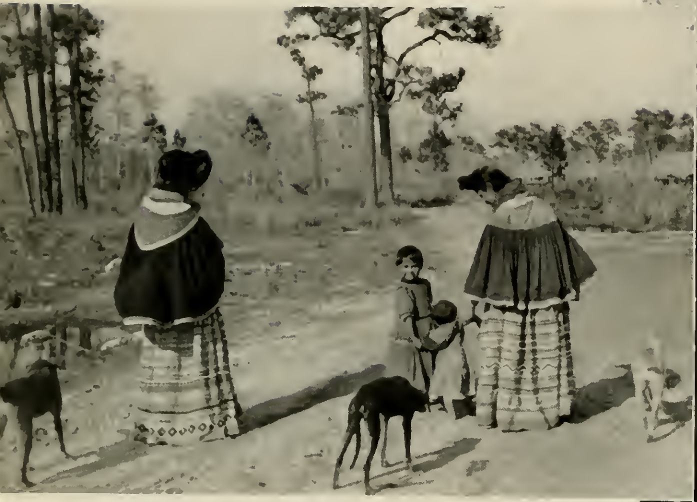
Trousers are worn by young Seminoles, like the one below, at the request of white society. When hunting during a wet season he is clad only in his long-tailed, gaily ornamented shirt, but he doesn't dare journey to town without pants



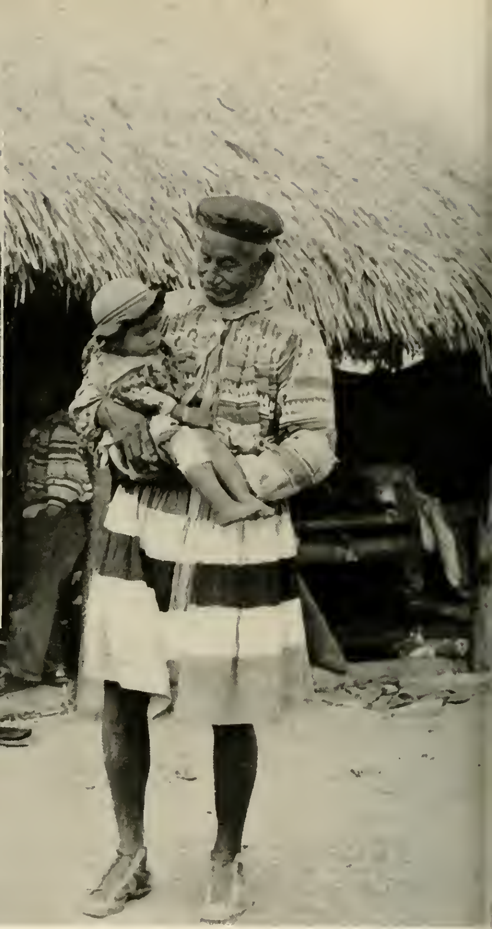
The distinctive headdress of Seminole women is practical as well as artistic. The hair is smoothed over a cardboard frame, which keeps the sun out of the eyes. The mirth discernible in their smiling faces is occasioned by the author's early efforts to learn their language



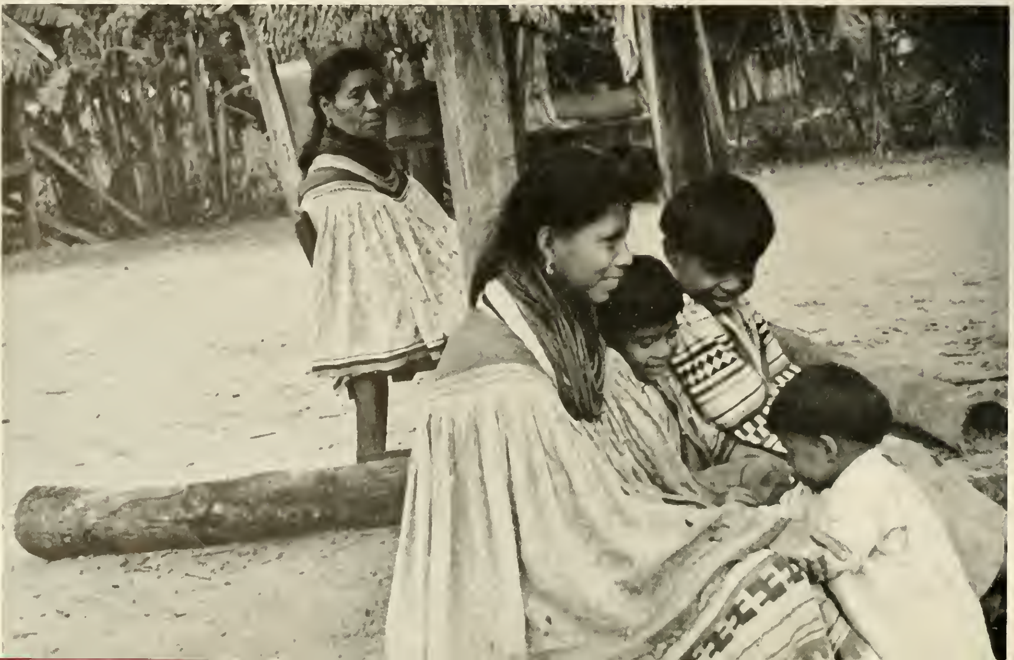
(Right) THE OLD MEN are effectionate and gentle with the little children



(Above) WOMEN'S SKIRTS are gaily colored and startlingly beautiful. Traders supply Seminole women with lovely shades of bright calico, which are manufactured into the finished product on a hand-driven sewing machine



ELDERLY SEMINOLES are conservative and aloof. The old woman remains in the background because she is still undecided whether the white visitor is her friend



Live dolls are the daily concern of Seminole girls of eight to twelve years. If there is no sibling, the older sister's child is often cared for, much to the delight of these "little mothers"

(Below) **Curiosity.** Seminole children are continually with their elders and take their attitudes and interests from them

(Right) A **Seminole widow** weaving a basket from special grass that grows only in a certain district of the Big Cypress country. Now that game is scarce, the tourist trade in souvenirs is becoming increasingly important

We were still eating breakfast when Cocky whispered to Leon, "Don't say anything, just look." An Indian path from one village to another passed within a few feet of our cook tent. Along this trail, bearing down on us like a ship under full sail, her voluminous skirts billowing, ploughed Mrs. Whitney Cypress, the matriarch, dignified, large, and imposing. Over her head she held an enormous palm leaf, so majestically poised that it seemed more a banner than an umbrella, although the rain poured off its tip like a cascade. It was her son who, after Leon's terrible accident in the 'Glades, came and visited us at our home in New Jersey and by his unselfish devotion helped make Leon's recuperation bearable.

The sun had come out, and I looked towards the horizon, across a vast grass-tufted, shallow lake. In it the vivid blue sky and white clouds were so clearly reflected that an Indian and his wife who came through the water seemed to be wading in the heavens. They had been forced to seek refuge on a higher hammock during the rain and high water.

The woman's skirt was held above her knees out of the water. The back of the man's head was shaved behind the ears, making a straight ridge of long hair around the front of his head. He carried his prized and well cared for twelve-gauge shot gun. Canvas packs slung across their shoulders, contained most of their possessions. They too passed me without showing that they were aware of my presence.

But two boys, one about Leon's age, whom I had known the year before, came over to get acquainted. Na-wa-ki's shirt was not made of as many tiny pieces, because his mother was dead and I had seen him that very morning finishing it and trying it on.

Two other figures, slinking furtively behind them, looked like scarecrows. They were caked with dirt from head to foot, their hair was matted and their clothes so rotted that even the safety-pins could hardly hold the snagged pieces together. I was told that the wife and mother of this pair had died and that during the season of mourning they could not change their clothes or wash and they must avoid human contact. A few days later I saw them dressed like any of the other Indians.

Our breakfast was hardly cleared away when old friends began to arrive. As-hi-gi was very pretty in a new dress, and straddling her hip was her child.

I wanted to enter into their conversation and life. I found it surprising that we could convey so much to each other without words. As I look back, I can appreciate some of my funny mistakes, at which they laughed merrily, but their enjoyment was never derisive. I was trying to say, "I said something to make her laugh (Ah-ni-a-pon-la-li-gone-at-so-bi-la-so-un-gus); but instead said, "I said something to make her leave her husband." This was greeted by subdued shouts of joy.

The winter of 1940 was cold and raw and it rained continually. We slept under five blankets, generally doubled for warmth. We wore two sweaters under our heavy overcoats and wrapped our legs in steamer rugs. The Indians suffered too and looked bulky in blankets and extra shirts. But one day it turned unusually warm. We were sitting in the Florida sun at A-lish-a-la-ki's village. Ne-hi, an unmarried cousin, was arranging her hair, and there is nothing in the world like the picturesque Seminole hairdress. First Ne-hi pulled her hair to the top of her head in a switch, and tied it at the base. Then came the curious cardboard frame, which is shaped like a large hat brim and is certainly an adaptation of the white woman's hat. This is covered with black cloth and wired at the edges. The shy Ne-hi pulled her hair smoothly over this and covered the whole with a net made of black thread. Finally she decorated the edge next to the forehead according to individual taste, with loops of beads and bright pins.

After Ne-hi had finished arranging her hair, a handsome young blade, tall, spare, and broad-shouldered, came around the *chi-ki.* The young girl was consciously unconscious. She pulled her hair brim coquettishly down over one eye and peeped coyly out from under it at the young man, using it as flirtatiously as any young lady of the Gay Nineties ever used a fan. The young man came and stood near her, half-turned away, making no direct advances. Her clear, café-au-lait skin colored with pleasure, and she cast winsomely demure glances at him—which were not wasted, for she married him at the Green Corn Dance not long after.

One night the next year about six o'clock I went to Ne-hi's mother's village in the Everglades, not far from my camp, and saw the *chi-ki* that Sho-pa-tsi had built for Ne-hi when he married her. The village was large and important, having about ten *chi-kis* where the individual families of the clan lived, with sometimes a *chi-ki* for the children as well, for as they grow to 'teen age they live in separate huts. When I approached the new *chi-ki,* I could not see that anyone was on the platform until I was close to them. Apparently they had not heard me. The husband had bathed, put on a new Seminole shirt, and his beaming black eyes were looking lovingly at his wife as he lay with his head in her lap and she affectionately stroked his hair.

That evening, Not-so-ha-e-tchi, a young council man, broad-shouldered and responsible, came to see us, followed by his new wife of sixteen, pretty and sweet and adoring. He was very much in love with her too, and showed it as obviously as any infatuated white boy. The people are merry and playful and they laugh and joke and make a game of everything.

One evening shortly before sundown, while walking through a path in the 'Glades, I came upon a pretty sight. The water was breast-deep in a pool, and here the women came to wash their clothes. As-hi-gi and her sister had soaped and scrubbed the family laundry on a log. As I watched them, As-hi-gi took the last wet skirt, drew it over a selected bush of the right size, where, presto! it would dry as smooth as though ironed. Two nude boys of about sixteen were with them, and they were all laughing and splashing each other, as As-hi-gi's small child looked on from the log where it perched. As I did not want to intrude or have them suspect me of spying, I quickly retraced my steps.

I was to learn that it was difficult for us to keep ourselves and our camp as tidy as did our Seminole neighbors. Differences in customs sometimes cause misunderstandings. Soiled pots here did not denote negligence but cleanliness. The Indian considers us the offenders, for we cook in pots that have been washed for several hours and must therefore be dusty. He washes his utensils just before he uses them.

It was a few mornings after this that I realized that something exciting was going on at the Tiger Camp, so I went over. Everyone was bustling. The fire, laid like the spokes of a wheel, was blazing in the middle of the morning, and Mrs. Squirrel Jumper was grinding corn. Around the fire, eight gophers, or land turtles, were cooking. A little boy was sitting on one of the logs stirring something that bubbled in the deep fat, like yellow cherries. Everyone was as pleased and excited as our children are during the preparation of a Thanksgiving feast.

Many Indians began to arrive from the various villages. None brought any food with them, and Mrs. Squirrel Jumper had much grinding to do. All were dressed in their best.

Several gay young women left the village and sauntered past the five young men who were standing just inside the fence. They smiled, looked sideways coquettishly, and the men returned their glances, laughing among themselves, just as white men and girls do on our country street corners. Suddenly they subsided meekly, for their chaperone, the large and dignified dowager, Mrs. Buffalo Cypress, came steaming along like a battleship. She looked neither to right nor left. Beautifully and correctly dressed, old Mrs. Grundy herself was seeing that her charges walked the straight and narrow also.

It was a great occasion, for Mrs. Squirrel Jumper, one of the old conservatives, had come to call. Cocky was making fudge in the cook tent. Leon, smelling something good and wanting to tease his sister by way of diversion, rushed in and grabbed some candy. A battle royal ensued, with Cocky as victor, and Leon spun out of the opening, hands and legs flying. Astonishment, incredulity, and arrested fear were expressed on the amazed faces of the women and children. I have never seen any quarreling or slapping nor heard any raised voices or bickering, either among the children or their elders, in the three winters that I have lived intimately among them. An effusive person is as undesirable in their eyes as a shouting, backslapping man would be in ours. No one impinges on another. Personality and time are individually owned.

After this episode, Mrs. Squirrel Jumper appeared more doubtful about us than ever. As Cocky moved around the camp, the boys' eyes followed her. One could see that they were wondering about her blondness, her curly hair, her little freckled nose, and her blue eyes that looked at them so frankly. She smiled as she brought over the pan of fudge to them saying to me, "I thought that this would help us to be friends." The Indian boys were bewildered and did not know what Cocky wanted them to do, so she put the pan into their hands and made signs for them to eat the candy. They took it, placed it on a log and talked about it together, then looked at it again, smelt it and felt it. Knowing a few words from the year before I said, "Im-pi-ki" (eat). With that, they took a little piece gingerly, but as soon as it was once tasted, it disappeared in a jiffy.

You must not imagine that the Seminoles accept food or presents without trying to repay the kindness. The night after the boys had eaten with us, the older brother brought me the heart of a palm tree, and As-hi-gi and her little daughter brought me a big canvas, which we excitedly unwrapped and found to contain some lovely flowering plants.

I was very much pleased, for I felt that we really could understand each other and that after all, Judy O'Grady and the Captain's lady, be they brown or white, are really all alike. But that very evening I had my doubts. I had been conscious that we were being watched. Remembering past history, I found it hard, after supper, to concentrate on the notes that I was writing up, for in the dark I had often seen the form of a man slither behind a mango tree that stood just outside my sleeping tent. This particular night was very black, and going to Leon's tent to kiss him good night, I was watching for snakes, as usual, walking with my flashlight, when suddenly I felt someone. My arm was seized and something thrust into my hand. The person disappeared. I had not heard him come or go. Trembling so that I could hardly turn the light, I saw that a bunch of rare exotic flowers from way back in the Everglades had been given to me. Later I learned that one of the older boys had gathered them and, perhaps being too shy to give them to me in front of the others, had chosen this terrifying manner. After this expression of good will I felt more confident.

How have these people acquired such gentleness and sweetness? What has taught them such honesty that money, food, or candy can be left where it is easily accessible and not be touched? Can the wise disciplining of their children be responsible? The babies are with their mothers continually and are surrounded by love and the security of knowing that they are wanted. Corporal punishment is administered to the young by a representative of the group. It is impersonal, and there is no individual resentment. Yet property is owned individually, even by the child, and his behavior is his individual responsibility to the group.

As-hi-gi's toddling baby upset a box from one of my chairs. The ensuing crash frightened her, and her face twisted to cry, but the mother caught her up to her breast, cuddling and crooning, comforting and nursing her until she slept. As-hi-gi does not always cuddle her child when she cries. If she receives some slight hurt or is thwarted in what she wants to do and runs crying to her mother, As-hi-gi will not reprimand her but will look off in the distance, seemingly unconscious of the child's existence. This attitude will persist as long as the baby continues to plead and pull at her skirts. Even here there is no aggression on the adult's part.

Julia, age five, was taking me to her village to see her make her doll's clothes, for the very young girls can sew well on the hand machine. She was running fast when she tripped on her long skirts and fell hard. It must have been very painful, and I rushed to her saying, "Oh, are you hurt?" She picked herself up, laughing to cover her discomfiture and shook her head violently, and to prove that it was nothing, she threw herself with all her force headlong on the ground again. No wonder these people had the fortitude to withstand us during the Seminole wars.

We felt great admiration for these people. Their acceptance of the inevitable, not supinely but with resourcefulness, has developed an adaptability that leaves no room for peevish frustration. Instead of resisting the heat, the wet, and the snakes, they have made their houses and their clothes comfortable under these conditions. Their frequent change of habitation has made material possessions a burden, but they are happy with few. Their necessities, such as costumes and roof thatch, are of exquisite workmanship, of which the Big Cypress are proud.

Many times I have looked across the 'Glades and seen boys walking with their arms thrown over each other's shoulders and known that one of them was my son, in his Seminole blouse. When I watched Cocky happily running and jumping with the Indian girls or playing ball with the men and boys, I was aware that we had learned an important lesson that had become part of us. Our understanding of people unlike ourselves had given us a real sympathy and deep affection for them. The words "truth," "sincerity," and "integrity" took on new meanings to me from my association with the Seminole; and new spiritual values made our popular words, such as, "material possessions," "ulterior objectives," "expediency" and "propaganda," seem sordid, indeed.

It was during the last part of April, some time before we had expected to come home, that the accident occurred which proved the real affection and interest that had grown up between many of the Seminoles and ourselves.

It was half past six and Cocky and I were hurrying to get supper. Suddenly I heard the most terrifying screaming, and Leon Jr., like a flaming torch, rushed past the tent away into the wilds. He had overturned the gasoline can on himself while trying to light a lantern and had caught fire. I had no time to snatch up anything to wrap around him. I had to catch him. I got him down on the ground and beat and squeezed out the fire, some way. I like to forget the horror of his pain, and that night. The consternation and sympathy of the Indians was very lovely. I did not know until afterwards, that Not-so-ha-e-tchi and many of the others stayed outside our tent until very late, and they were there again early in the morning helping pack and lifting Leon gently onto the air mattresses and pillows. His playmates hung over the side of the truck and looked at him with unmistakable affection and solicitude, and as we pulled off across the swamp and I waved my two hands, bandaged like baseball mitts, to them, every Seminole took off his hat and waved it until we were out of sight.

We had asked Mr. Hanson to drive one of our cars home for us and bring Fa-hi-ha-tchi Cypress with him, for a short visit.

Two weeks later, in the hospital in New York, Leon with quivering lips, swallowing hard and, trying to control his shattered nerves, choked, "Mummy, can't the doctors understand that I must be home when Fa-hi-ha-tchi gets there? Everything will be so strange to him." Leon looked around the room. "Why, he's never lived in a house, he doesn't even sleep in a bed or eat at a table."

But the skyscrapers of New York, the crowds of people after the solitude of the wilderness, the curious stares of strangers attracted by his shamrock green trousers and gaily patterned blouse, the elevator, like a room that suddenly flew skyward,—all these had not existed for Fa-hi-ha-tchi until he saw Leon.

With two strides, the Indian had crossed the little white hospital room and with the protective tenderness of his 23 years for a little sick fellow whom he loved, he sat contentedly by his bedside as though guarding his playmate from future harm.

THE GREAT ANIMAL INVASION

Continued from page 211

ica and, by analogy, to fill in some of the interpretive gaps left by incomplete factual knowledge of that earlier event.

This is what happened: the great Mesozoic dinosaurs and other -saurs also disappeared in South America at the Great Dying Time, and the Cenozoic started there, as in North America, with the appearance of the varied archaic mammals of the Paleocene. Then South America was isolated by the sea and it became an island continent. The modernized Eocene invaders of North America could not reach South America, and while the archaic fauna was fighting a losing struggle in the north, it had no competition (outside its own ranks) in the south and continued to flourish there. It evolved, too, of course, but the South American fauna was essentially archaic almost to the end of the Pliocene—a mere one or two million years ago—which was long after the great majority of archaic mammals had died out in the north.

Then the Isthmus of Panama rose. The modernized mammals of North America, evolved now into such familiar forms as foxes, raccoons, bears, wild cats, peccaries, deer, horses, and tapirs, invaded South America over this land route. In the ensuing bitter struggle a few of the archaic forms, like the armadillos, managed to survive and even to get a foothold in North America, but almost all of them became extinct and were replaced by the modernized mammals of northern origin. It was the Eocene struggle over again, long delayed by the accident that South America was an island in the Eocene and for long after.

For use in schools and colleges, a set of 25 Kodachrome slides on the Evolution of the Horse is now available, complete with descriptive commentary. Prepared by the Department of Education at the American Museum of Natural History, this set embodies the best and latest information on this classic paleontological question, and shows many of the unique exhibits at the American Museum.

The set is priced at $15.00 and is suitable for use in projectors taking the popular 2 x 2 inch slides.

MANGANESE

Continued from page 217

them are shapeless, more or less compact, black masses, and, as mined, they are variable in composition.

Sometimes fine, sharp crystals of manganite and pyrolusite are found, but they are so rare as to be mineral specimens, not ores. The 1,200,000 tons of manganese ore used annually are these natural formless black oxides, and the artificial equivalents derived from the carbonate.

Manganese ores come to us from many lands. The principal exporters are the Gold Coast, India, Union of South Africa, Brazil, Russia, Cuba; and the American production of 1940 amounted to less than the imports from Cuba. None of these foreign sources has, as yet, been lost from the control of friendly nations, but difficulties of obtaining the ores from such distant places are increasing. There is no geological reason why manganese should not occur in this country in large quantities, except that it doesn't seem to, at least in rich deposits. The oxides of the workable deposits are secondary in origin, that is, they are derived from other manganese minerals through the process of weathering. Naturally it is a happy circumstance when iron ore has some manganese already in it. This often happens in bog iron ore—ore which was precipitated from waters in marshy places (as in the region of Lake Superior),—for manganese can be deposited by the same process of precipitation. Some of our best manganite crystals have been found in cavities in this type of ore.

We probably shall be able to work out our manganese needs well enough. Economies are being made in its use. Greater care in determining the least amounts necessary to get a workable steel have resulted in a reduction of the consumption; and a stock pile of some proportions has been built up. Also, recent government enterprise in the search for new processes of enrichment and recovery and the development of large scale operations will help us to become self-sufficient for the war period. But don't think that private enterprise could or should have done it under normal conditions as long as low cost, high grade manganese ores were available in other lands. One could only wish that those who are doing the most criticizing now had shown a little more foresight and enterprise in anticipation of the present emergency, instead of initiating the present well-planned campaign so late.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 240

1. If pursued by an adult grizzly, would you be safe up a tree?

Yes. . . .   No. . . . . . .

2. The Seminoles live in

(a) Florida

(b) North Dakota

(c) British Columbia

3. Are the animals in North American Hall stuffed?

4. A scientific guess set up for examination and testing is a

(a) Hypothesis

(b) Theory

(c) Axiom

5. Moose, caribou, and musk-ox are all

(a) Members of the deer family

(b) Herbivorous

(c) Restricted to Alaska

6. Where is the only point in the United States at which four states come together?

7. What is the world's largest carnivore?

8. If they could be caught, mountain sheep would help greatly to overcome the present shortage of wool.

True. . . . .   False. . . . .

9. The female moose has antlers.

True. . . . .   False. . . . . . .

10. What plant menacing U. S. navigation is named after the object which the ancients threw in the path of military elephants to halt their attack?

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North American Camera Safari—indoors

By CHARLES H. COLES

Chief Photographer,
American Museum of Natural History

THE true-to-life displays in the American Museum's new North American Hall throw out a challenge to the cameraman who would photograph them. As with other exhibits, certain visitors are sure to want to secure a permit to use a camera in the hall; and if the pictures are for personal use and not for publication, the permission is usually easily secured through request to the Director. Whether one aspires to capture these animals on film or is simply interested in special photographic problems, a few words about the indoor camera safari may serve a purpose. In these life-like exhibits, new heights have been reached in the use of color and lighting, so that the photographer is on his mettle to do justice to their artistry.

The point of view

Basically, the choice of the camera position is, of course, determined only by the amount to be included in the photograph. When a comprehensive view showing the entire group is wanted, the camera is placed at the proper distance from the exhibit to take in the edges but stopping perhaps just short of the frame of the case, as some persons feel that this impairs the natural effect. However, because the background of the group is painted on a curved surface, the height of the camera cannot be left haphazard. The perspective of these scenes will be correct only from one point of view: that from which the background was geometrically projected when the artists laid it out in charcoal. This point corresponds to the eye level of a spectator standing about three feet from the exhibit and directly in front of it. From this point of view a level horizon, like the skyline of Grand Canyon in the Mountain Lion Group, appears as a straight line. Photographed from above or below this level, the skyline would appear as a curve, producing an effect never observed in Nature.

To understand the finer points, it must be realized that the foreground of the group, containing the animals, is rendered in a solid, three dimensional form, whereas the background is painted in two dimensions. This means that at some place in each group solid objects must blend in with flat ones. The skill of the artists who paint these backgrounds is so high that the spectator, unless constantly reminded, finds himself fooled into the illusion that he is viewing real distances. This is in spite of the fact that we are equipped with two eyes capable of discerning depth in objects up to a distance of about 200 feet. The perfection of perspective in the groups will be strikingly impressed on the visitor if he will stand at the center of the glass panel and close one eye. With head held still, it is almost impossible for him to determine with certainty where the foreground leaves off and the painting begins.

Since the camera has one eye instead of two, it is possible to place it so that the perspective of the foreground matches that of the background, and then no dividing line will appear in the picture to destroy the illusion of reality.

These factors require that the cameraman place his lens about five feet from the floor, that is, on a level with the horizon. A wide-angle lens will enable the photographer to take in the whole group from a position that is closer, which is usually a better position with reference to the perspective of the group.

Illumination

The lighting effects of the groups have been worked out with painstaking care to give the effect of outdoor illumination. The addition of any other lights to the existing ones may destroy the effect so skillfully achieved.

Because the lights are placed in a chamber above the front of the group, an obviously difficult achievement is the proper illumination of the figures nearest the glass. Even though they receive sufficient diffused illumination for a realistic effect when viewed by the human eye, the camera may record these animals darker than they would appear out-of-doors.

In taking the photographs reproduced in this issue of NATURAL HISTORY, the Museum photographers provided additional diffused light. In other halls this effect has been accomplished by throwing powerful spotlights on the ceiling so that their illumination is reflected upon the figures in the group. But in North American Hall the dark blue of the ceiling precluded this method. Four lamps that could be raised to a height of fourteen feet were placed near the group and directed downward so as not to strike the background. The lamps in these were as small as 60 watts for the groups that were darker overall, and 200 watts for the brighter ones. Tiny spotlights were sometimes used to brighten especially dark fur, but great care was exercised to prevent the light from these from spilling over and producing unnatural shadows. By placing these lights as close as possible to the camera, the shadow cast by a figure was concealed by the figure itself.

Color filters need rarely be used in taking black-and-white pictures of these groups, because of the exactness of their coloring and the ability of modern films to interpret most colors so accurately that correction is unnecessary.

For a realistic effect, the lens aperture should be left fairly wide. This puts the background slightly out of focus and adds depth to the picture. It also gives a quality we are used to seeing in a picture of a living animal taken in the field, where the lens is usually opened up to allow a rapid exposure.

Some of these preparations may seem complicated and beyond practical limits for a visitor to the hall, but excellent photographs of these exhibits are possible with no more equipment than a camera and a tripod. The most important thing beyond these irreducible necessities is a knowledge of just what your equipment will do and how to get the most out of it under unusual circumstances.

DO NOT MISS

THE ICE AGE, winnower of life on earth: its prelude and its far-reaching effects, will form the theme of the seventh and eighth articles in NATURAL HISTORY's panoramic series on animal history in North America. Paleontologist Edwin H. Colbert takes up the narrative where G. G. Simpson has left off in the current issue. He will depict the times when mastodons reigned supreme, and that later day when woolly mammoths stalked the icy fastnesses of what is now Nebraska.

No modern big-game hunter seems likely to turn up with a 45-foot crocodile in his bag. But Dr. Barnum Brown did! One of the world's outstanding fossil diggers lives to tell the tale in his article **THE LARGEST KNOWN CROCODILE,** soon to be published in these pages.

•

The camp life of a veteran archaeologist exploring some of the earliest Americans' hunting grounds in Montana will be recounted with rare charm by **NELS C. NELSON.**

YOUR NEW BOOKS

PLANT HUNTERS IN THE ANDES ● APACHE WARFARE
A HISTORY OF SCIENCE ● THE CURIES AND RADIUM
THE CREEKS IN OKLAHOMA ● WEATHER PHENOMENA

APACHE DAYS AND AFTER

- - - - by General Thomas Cruse
Edited by Eugene Cunningham

Caxton, $3.50

ANOTHER Apache book deserving notice by those interested in these Indians is this autobiographical sketch by a veteran army officer who served through the wars with that tribe from 1879 to 1887. Some 240 pages are given to thrilling descriptions of fights with such famous leaders as Victorio, Chatto and Geronimo. There are full accounts of such engagements as Memtrillo, Victorio's destruction, Cibicu and Fort Apache, Dry Wash, and the surrender of Geronimo. Also there are interesting sketches of Generals Crook and Miles.

The author is General Thomas Cruse who, when just out of West Point, began service in Arizona in 1879 and was retired in the course of the World War in 1918. Of the 328 pages of text, 234 are devoted to the Apache campaigns. Years later Cruse was to discover that most of the engagements in which he participated and in which many enlisted men lost their lives were not even listed in the government records in Washington. Cruse seems to have been a man of rectitude, every now and then crying out against political manipulation and graft in Army affairs about which he could do nothing. Since Cruse writes as an eyewitness, those interested in the Apache wars will find some new information on controversial questions. For example, Cruse gives details to corroborate the disputed claim that Geronimo was not captured but that he surrendered. He states that an American officer went alone into Geronimo's camp and persuaded the treacherous chief to surrender.

CLARK WISSLER.

A SHORT HISTORY OF SCIENCE TO THE NINETEENTH CENTURY

- - - - - - - - - - by Charles Singer

Oxford, $3.75

IT is no longer necessary to argue that the history of knowledge is as important and is as essential a part of a cultured person's comprehension of his world as is the history of nations or of arts. For the reader who wants one book on the history of knowledge, whether for pleasurable reading, intellectual stimulation, or factual reference, this is the best book that we have encountered.

Science, according to the definition that prefaces Singer's work, is an active process of acquiring or making knowledge. It is thus distinguished from technology, the application of such knowledge to a material end, which is almost excluded from this history. Science is, however, more than the acquisition of facts. It is also the organization and, at least, the attempted understanding of facts. This broader, more interesting, and more philosophical aspect of science is the essential theme of the book.

This theme is followed mainly in terms of individual scientists: what each learned that was new, and how this affected his thought and that of his successors. The problem of giving unified, comprehensible treatment of a subject so complex and confusing is solved with exceptional skill. Through all details and personalities a general, impersonal movement is always clear, from the rise of mental coherence among the Greeks through the great failure of later antiquity and the Middle Ages, to the resurgence of learning and its triumph in the nineteenth century. Much nineteenth century science is included, especially biology, and the history gives more than it promises by bringing the reader to the threshold of contemporaneous science.

There is an adequate Index of Persons, but a few more pages might have been added to the 400 of this short history to include an Index of Subjects and a Reading List.

G. G. SIMPSON.

WEATHER AND THE OCEAN OF AIR

- - - - by William H. Wenstrom

Houghton Mifflin, $4.50

HERE is an authoritative and entirely readable book on the science of weather. It carries a graphic and detailed account of the "ocean of air" which surrounds and overlies us, and of the wind currents which activate it. Clouds, winds, rain, snow, cold fronts,—all of the principal phenomena, and expressions of the phenomena, of the weather are clearly discussed, and in considerable detail. The treatment is based upon the essentially new methods developed by the introduction of the "air-mass-and-front analysis" theories, and as such is entirely up-to-date and modern.

The author, William H. Wenstrom, is a major, retired, of the United States Army Aerological Service. For a number of years he was in charge of the Army Weather Stations throughout Pennsylvania, Maryland, and Virginia and later was, for three years, the meteorological officer at Bolling Field, D. C. His authority is, therefore, unquestioned, and the impressive list of acknowledgments to specialists who have read and criticized the various chapters, leaves no room for doubt as to the authenticity of the material presented.

Particularly valuable are the data on home weather installations, observations, and forecasting; on farmer's weather, mariner's weather, and aviator's weather. In these days of war, when weather reports and forecasts are to be classed as information of military importance, an ability to foretell at least extremes of weather becomes of increasing value to people in many fields.

Interesting and very well-written, this book has all of the information to be expected from a textbook on the subject, without lapsing into the less interesting "textbook style" of writing. It is enthusiastically recommended.

H. E. VOKES.

THE ROAD TO DISAPPEARANCE

- - - - - - - - - - -by Angie Debo

University of Oklahoma Press, $3.50

ANGIE DEBO was reared in a pioneer community at Marshall, Oklahoma where she has known from childhood the folkways of the Indians. She was educated at the University of Oklahoma where she received her A.B. degree and her Ph.D. She also earned a graduate degree at the University of Chicago. Miss Debo is the author of *The Rise and Fall of the Choctaw Republic,* which won the John H. Dunning prize of the American Historical Society for the best book submitted in the field of United States history in 1934.

The Chickasaws, Choctaws, Cherokees, Creeks, and Seminoles are known as "The Five Civilized Tribes." The Creeks, like the rest of these southeastern tribes, were forcibly removed by the United States Government from their ancestral homes and made to travel the "trail of tears" to what is now Oklahoma. By the way, there has recently been established near Macon, Georgia the Ocmulgee National Monument on the site of a prehistoric Creek settlement, which has furnished indubitable evidence that the people who constructed the remarkable mounds at that place were ancestors of the historical Creeks.

But this book is mainly about the Creeks in what is now Oklahoma. It is the story of the struggles of this tribe, or nation as they were known after their removal to this untried home west of the Mississippi. As Miss Debo says, they were friendly toward the white man until his encroachment made them resentful and desperate. They found that they had no guile to match broken promises. It is an absorbing story, but a sad one, another chapter in Helen Hunt Jackson's *Century of Dishonor*.

Te Ata.

PLANT HUNTERS IN THE ANDES

- - - - - by T. Harper Goodspeed

Farrar & Rinehart, $5.00

THE author of this most readable book is Professor of Botany and Director of the Botanical Garden at the University of California. The story is told of two botanical expeditions sent out by the University at Berkeley, one in 1935-36 and the other in 1938-39. The personnel consisted of Doctor Goodspeed, his wife, and eight North American botanists, and the ground covered was mainly Peru and Chile. Explorations were made from near the equator on the Ecuadorian border to southern Chile, with a side trip to Juan Fernández, "Robinson Crusoe's Isle" in the South Pacific. Their plant hunting was not limited to the snowy highlands, but included the barren coastal deserts ("drier than the Sahara") and the tropical and temperate rain forests as well. The book is illustrated with 125 beautiful, well-selected photographs. There is, however, an apparent slip in the caption of Mount Osorno, the "Fujiyama of South America." In the wealth of illustrations, this reviewer missed one of the highly-prized amancay "lily" (*Ismene Amancoe*),—really a member of the amaryllis family—, that he saw, in 1937, blooming at the foot of the Andes near Lima.

One of the main objects of the expeditions was to search for wild species of tobacco (*Nicotiana*), and these they found in surprising numbers from small species to the tree tobacco (*Nicotiana tomentosa*) which they found in Peru growing to a height of 40 feet. Doctor Goodspeed is probably the foremost authority on this group of plants. He has made tobacco plants a lifetime study, and he has in the Botanical Garden at the University of California the world's largest collection of living plants of *Nicotiana*.

Many other kinds of plants, however, were collected, and interesting facts about them are woven into the story. The book is nontechnical and human. It is an explorer's book, containing the things that everyone wants know. Doctor Goodspeed is a gifted raconteur, and he has given us a fascinating book.

Clyde Fisher.

RADIUM TREASURE AND THE CURIES

- - - - - - - by Irmengarde Eberle

Crowell, $2.00

THIS small, popular book on Madame Curie and her momentous discoveries is intended for young people, and the author has made a most readable story of it. Commencing with Marie Curie's childhood, she traces the development of her interest in science and her determination, despite great handicaps, to achieve success in that field. Pierre Curie's background and progress are similarly followed to their meeting, marriage, and joint experiments and discoveries. For the author makes it clear that Pierre Curie's part in the discovery of radium was no small one, though his fame is usually overshadowed by that of his wife.

Following the biography of the Curies, some mention is made of the occurrences of radium, its recovery from the ore, and the uses to which it is put. The book is interestingly written, and should prove popular with the audience for which it is intended, even though the details are often rapidly skipped over—perhaps in a desire for brevity.

F. H. Pough.

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NATURAL HISTORY Magazine

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Answers to Questions on page 237

1. Yes. Young grizzlies climb, but adults do not
2. (a) The Seminoles are an Indian tribe living in Florida. See page 226
3. No. The animals in North American Hall are mounted on a hollow manikin and are so light that they can easily be lifted
4. (b) A scientific guess set up for examination and testing is a *hypothesis*. A *theory* is a supposition supported by principles; and an *axiom* is an established principle. See page 210
5. (b) Moose, caribou, and musk-ox are all herbivorous. See pages 196, 204, 199
6. The only place where four states come together is at the four corners formed by Utah, Colorado, Arizona, and New Mexico. See page 215
7. The world's largest carnivore is the Alaska brown bear. See page 195
8. False. Although the mountain sheep is a true sheep, its coat is not woolly and is too coarse. See page 198
9. False. The female moose has no antlers and is only about three-quarters as large as the male. See page 196
10. Answer in next month's Natural History

May

NATURAL HISTORY

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LETTERS

SIRS:

. . . May I add that I have enjoyed very much being a Member of the Museum. . . . I am a very busy Sector Warden, but when the NATURAL HISTORY Magazine arrives each month, I . . . take time out to relax and read it from cover to cover. It is both educational and immensely interesting. I love animals and birds and enjoy stories about them.

MRS. EMMY NEWMARK.

Brooklyn, N. Y.

* * *

SIRS:

. . . NATURAL HISTORY is the most interesting and informative magazine I know of. I look forward to its arrival every month and have a hard time to put it aside when I should be doing something else. . . .

ROY W. NICKERSON.

Madawaska, Me.

SIRS:

I just received the Membership Certificate, and am greatly pleased with NATURAL HISTORY Magazine; it is wonderful.

CHARLES DUKE.

Chicago, Ill.

* * *

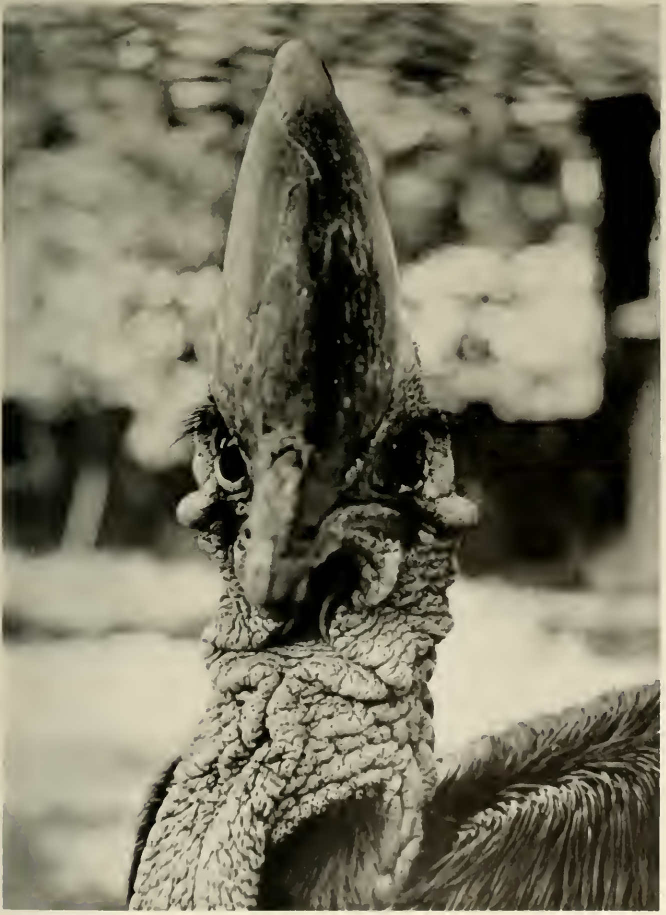
SIRS:

As one of many who always looks forward to receiving your intellectual magazine, may I comment on the very interesting article by Miss Cypher, entitled "The Story of Our Map."

I shall always cherish your valuable magazine, as it contains learning of the highest standard.

A. ALLAN CAMPBELL.

Port Washington, N. Y.



Penguin photo, taken at the N. Y. Zoological Gardens

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Natural History

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Above illustration Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

HENRY FAIRFIELD OSBORN

For him the dry bones came to life
And giant forms of ages past
Rejoined the pageant of the living
—William K. Gregory

HENRY FAIRFIELD OSBORN was president of the American Museum of Natural History for 25 eventful years from 1908 to 1933, and his death in 1935 marked the close of one of the greatest careers in the long history of the institution.

Last month on the occasion of the fourteenth annual Members' Visiting Day, solemn tribute was paid to his memory. As a fitting prelude to the opening of the new Hall of North American Mammals, Dr. William K. Gregory, one of Professor Osborn's most distinguished students, and Dr. James Rowland Angell, former president of Yale University, addressed the huge gathering prior to the unveiling of a bronze of the late president sculptured by Joy Flinch Buba.

Speaking of Professor Osborn as a mammalian paleontologist, Doctor Gregory showed how his inspiration stemmed directly from those nineteenth century giants, Darwin and Huxley. He traced his career through the founding of the Museum's paleontology department up to his tremendous monographs of later years, notably that on the Proboscidea. Doctor Angell emphasized the "creative" element in Osborn's character which, he said, was confined to no one line of endeavor. As scientist, executive, explorer, and man of religion, Henry Fairfield Osborn was equally inspired. The future can only enlarge his fame.

THE MUSEUM ATTAINED GREAT
FOUNDER AND H
THE DEPA

AMNH photo by Charles H. Coles

UNVEILING. Mr. A. Perry Osborn, First Vice-president of the American Museum of Natural History, stands beside the bust of his father, Henry Fairfield Osborn. Beside him are his sister, Mrs. Jay Coogan, and Joy Flinch Buba, who sculptured the bust

---

SIRS:

. . . I would like to say at this opportunity that this magazine is the most interesting and valuable I have ever subscribed to—I am a sculptor of animals and birds—and is particularly welcome in this somewhat isolated spot.

BEORINE BORONDA.

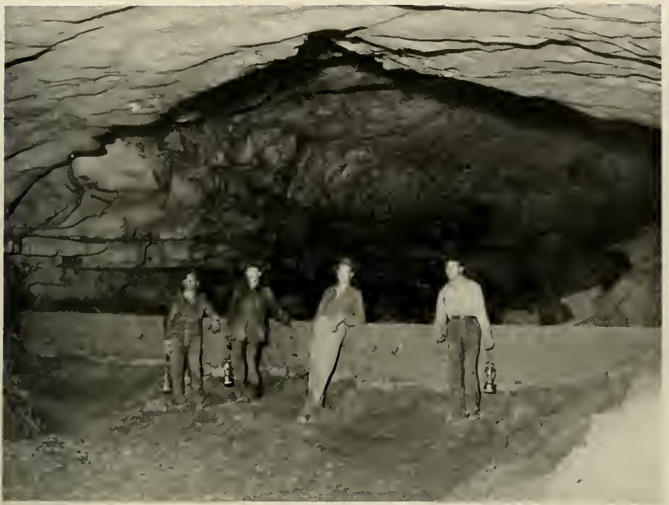
Trinidad, B. W. I.

SIRS:

I would like to express my gratitude and praise for the wonderful photographs you have in your magazine. They are beautiful to look at and yet they add to my knowledge of photography.

D. J. TASLEY.

Bronxville, N. Y.



Photo, Courtesy of the U. S. Department of Interior

A natural dam in Mammoth Cave, not yet open to the public. An irregularity in the floor possibly started the dam, when water rippling over it precipitated calcium carbonate. The dam is now dry. Note the travertine "corn flakes" in the foreground

SIRS:

The "Letters" section of NATURAL HISTORY for last October included a letter from Duane Featherstonhaugh of Schenectady, New York, and a picture of a limestone dam in Balls Cave near Schenectady. This feature appears to be the same type as two travertine dams in the New Discovery section of Mammoth Cave National Park in Kentucky, the larger of which is shown in the accompanying photograph. It is 42 feet three inches long and a little more than four feet high. The smaller dam, about twelve feet farther downstream, is only about two and one-half feet high.

Although the cave is not yet open to the public, the geological report on the formation of these dams might be of interest to your readers. In 1939, Mr. Donald C. Hazlett of the National Park Service investigated the New Discovery section of Mammoth Cave and described the larger dam as follows:

"Perhaps the most unusual feature in the New Discovery is the large travertine dam already erroneously called the 'Onyx Wall.' This dam impounded water for a small lake approximately 40 feet wide and 70 feet long, the width, length, and depth increasing as the dam was built higher and higher.

"Deposition of calcium carbonate at the dam site probably began because of an irregularity in the floor which caused a rippling of the water which in turn caused a liberation of carbon dioxide. With this loss of carbon dioxide from the water, calcium carbonate was precipitated. In this manner the deposit of travertine was gradually built up and formed the dam. Another factor is that there was probably in early times an outside opening and the air currents resulting facilitated such deposition. The currents of atmosphere likely had a carbon dioxide content below that required to maintain equilibrium with the carbon dioxide of the water and the escape of gas from the water was favored, thus causing precipitation. Also temperature changes caused by the air currents would tend to bring about deposition.

"Another unusual type of travertine deposit which has developed in connection with these small lakes is the flake-like particles (which resemble corn flakes) that have collected from three to ten inches thick in the lake basins. It seems that these deposits of calcium carbonate were formed on the surface of the water as an ice-like film which later broke up into flakes and settled to the bottom."

CARL P. RUSSELL,
Supervisor of Interpretation.
National Park Service,
Washington, D. C.

JUNIOR
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MAGAZINE

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Longines Watches have won 10 world's fair grand prizes, 28 gold medals

Illustrated: Longines Trinidad (top left) $93.50; World's Fair LA (top right) $67.50; World's Fair strap (center) $67.50; Hall of Fame man's bracelet $82.50

SIRS:

I read with a great deal of interest the article, "The Story of a Tree," by H. E. Vokes, appearing in your February, 1942 issue. This is a fine presentation of the story of the origin of the petrified wood of this area, and we are glad that it received the prominence of publication in your magazine.

There is one point in the article that we must question: "the particle by particle" replacement of wood by silica. It is true that the long accepted and generally held theory of the petrification of wood is a molecule by molecule, cell by cell replacement. There is little or no factual basis for this theory, however, and Dr. William C. Darrah of Harvard University and Dr. Chester A. Arnold of the University of Michigan have recently presented evidence* indicating that the replacement theory cannot adequately explain the phenomenon of petrification.

As I understand the replacement hypothesis, one of two possibilities must occur. Either there is a direct chemical reaction between the inorganic solutions present and the cellulose and lignin making up the wood, or the original organic material was dissolved away and the mineral immediately took its place. Doctor Arnold effectively answers these alternates by pointing out the lack of evidence to support a chemical combination of most inorganic substances and the substances composing wood and the very insoluble character of cellulose and lignin. Corroborative evidence has been obtained in experiments conducted in Petrified Forest National Monument where we have dissolved the silica of petrified wood in hydrofluoric acid and have found that some specimens have a residue of woody matter.

We now believe that we must explain the petrification process as an infiltration of mineral solutions with subsequent deposition of minerals, rather than as a direct replacement. Some decomposition due to hydrolysis or fungous action was undoubtedly present prior to the mineral deposition. The degree of this decomposition must have a direct relationship to the amount of woody matter now retained in the petrified wood.

This explanation eliminates the questionable chemistry of the replacement theory. Certainly we must admit that the assumption of direct replacement is untenable and that the term "deposition" better describes the process of petrification.

BENNETT T. GALE,
Park Naturalist.

Petrified Forest National Monument,
Holbrook, Ariz.

* * *

SIRS:

A captive garter snake gave birth to a litter of sixteen snakes while I was watching them. One after another they were expelled as the female wandered around in the four by four terrarium. Less than an hour after the last snake was born, I noticed one of the babies swallowing another. I let the process go on until the swallower could swallow no more and then preserved both of them.

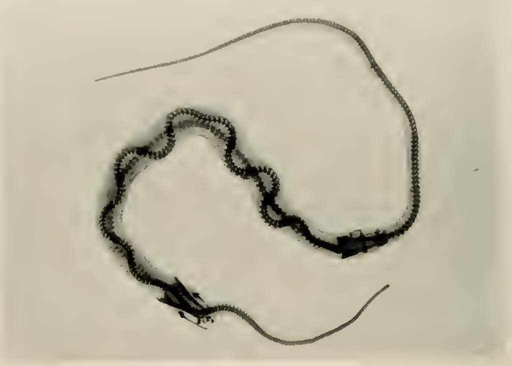
Using the sodium hydroxide and glycerine method of clearing and staining with Alizarine Red S, I cleared the snakes, and they were then photographed by Arthur Smith of the Zoology Department.

The actual specimens are perfectly transparent and every structure can be clearly seen. The swallower is lying on its back in the photograph.

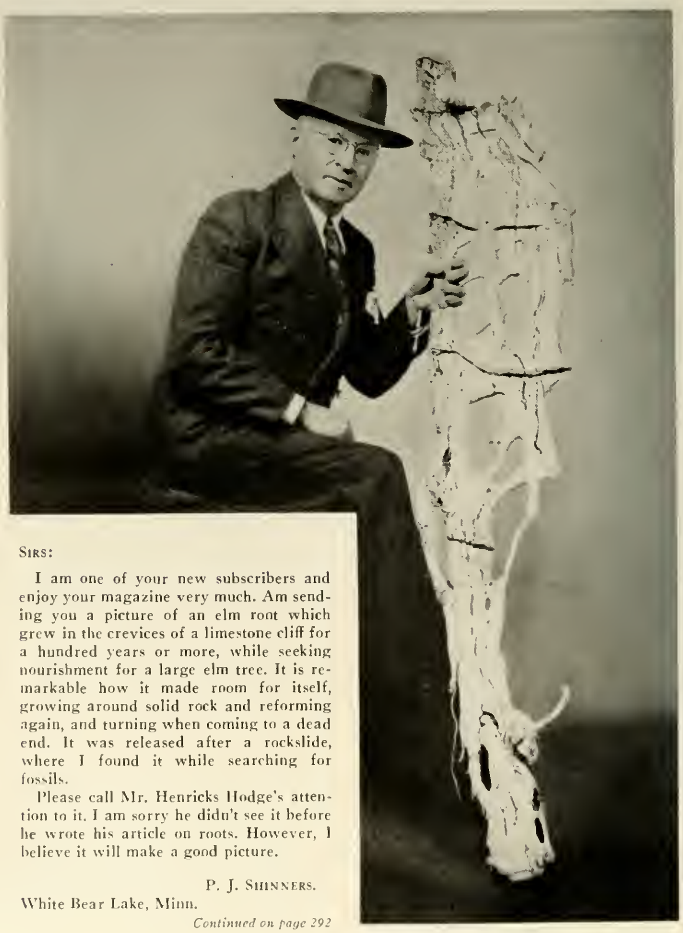
Perhaps this will be of interest to the readers of NATURAL HISTORY Magazine.

HOWARD E. EPSTEIN.

Cornell University, '44,
Ithaca, N. Y.



An actual photograph of a snake within a snake, the tissues having been rendered transparent



SIRS:

I am one of your new subscribers and enjoy your magazine very much. Am sending you a picture of an elm root which grew in the crevices of a limestone cliff for a hundred years or more, while seeking nourishment for a large elm tree. It is remarkable how it made room for itself, growing around solid rock and reforming again, and turning when coming to a dead end. It was released after a rockslide, where I found it while searching for fossils.

Please call Mr. Henricks Hodge's attention to it. I am sorry he didn't see it before he wrote his article on roots. However, I believe it will make a good picture.

P. J. SHINNERS.

White Bear Lake, Minn.

Continued on page 292

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* Darrah, William C., "Changing Views of Petrification," *The Pan-American Geologist*, August, 1941.
Arnold, Chester A., "The Petrification of Wood," *The Mineralogist*, September, 1941.

Railway Excursion and Buffalo Hunt

An excursion train will leave Leavenworth at 8 A. M. and Lawrence at 10 A. M. on Tuesday, October 27, 1868, and return on Friday.

This train will stop at the principal stations both going and returning. Ample time will be had for a grand BUFFALO HUNT ON THE PLAINS.

Buffaloes are so numerous along the road that they are shot from the cars nearly every day. On our last excursion twenty buffaloes were killed in a hunt of six hours.

All passengers can have refreshments on the cars at reasonable prices.

Tickets for round trip from Leavenworth, $10.

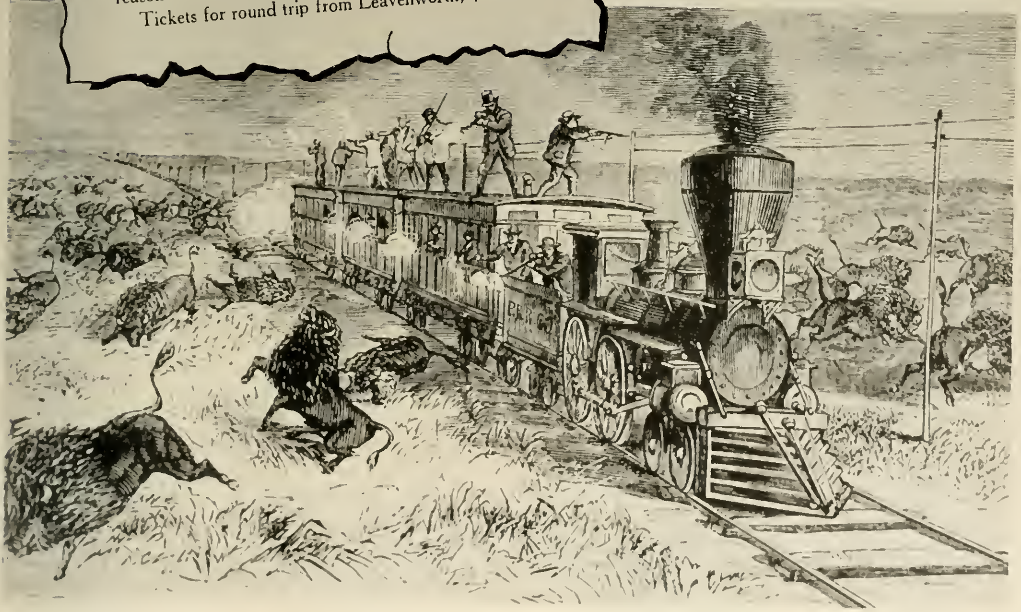
By BRUCE BROWN

The advertisement at left was printed in a Cincinnati newspaper 73 years ago. Then the bison or buffalo was the King of the Plains. Now it is almost extinct. Where probably 60 million of these animals roamed the ranges of America at that time, there are only a few more than 5000 now living on federal, state, municipal, and private domains.

The country is less picturesque without them. But the buffalo of today has nothing to fear, and that's his side of the story. In the interest of national resources in wildlife, Americans should remember stories like this, lest our abundant heritage of yesterday become a hopeless dearth tomorrow.

(Below) Slaughter for a pastime (From a woodcut of 1883)

The Bettmann Archive



ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Spring, 1942.

SUNDAYS over the Mutual Broadcasting System from 9:30 to 10:00 A. M.

This Wonderful World. Quiz program, with young people answering questions on nature subjects.

WEDNESDAY over the Columbia Broadcasting System Network from 9:15 to 9:45 A. M. (Central Time: 2:30 to 2:55 P. M.; Mountain Time: 9:30 to 10:00 A. M.; Pacific Time: 1:30 to 2:00 P. M.)

Lands of New World Neighbors. (New Horizons: C.B.S. School of the Air.) The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

WEDNESDAYS, May 6, and May 20, over WNYC from 3:30 to 3:45 P. M.

Know Your Museum.

FRIDAYS over the Columbia Broadcasting System Network from 4:15 to 4:30 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.

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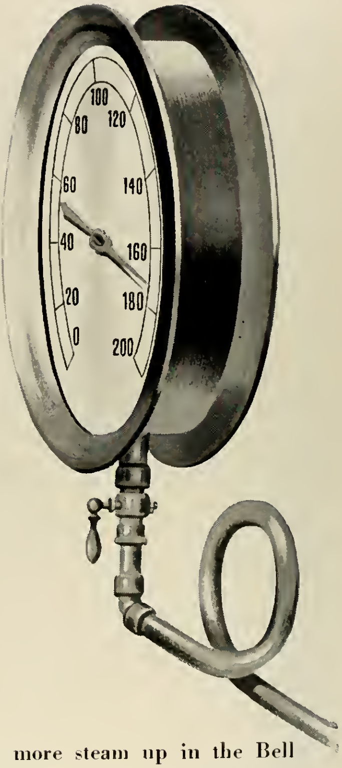

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Wayne Moody Faunce, Acting Director

VOLUME XLIX—No. 5 ★ ★ ★ ★ ★ ★ **MAY, 1942**

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Assistant Editor: Ruth Gannett, B.S.

Editorial Assistant: Katharine Lahee, M.A.

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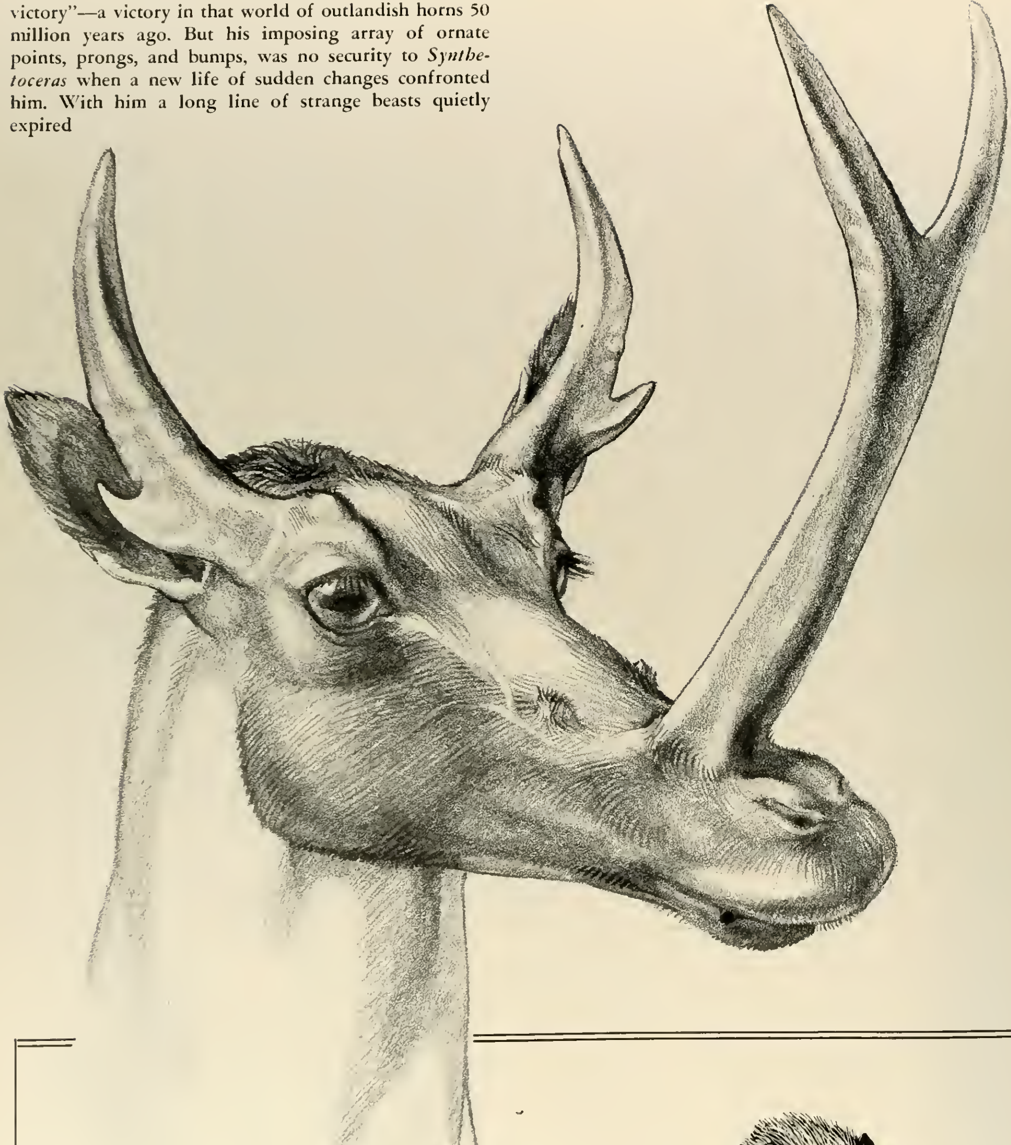
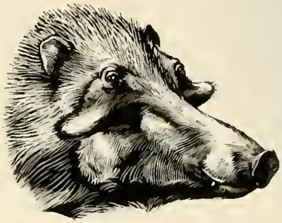
THIS FANTASTIC CREATURE unwittingly sports a "V for victory"—a victory in that world of outlandish horns 50 million years ago. But his imposing array of ornate points, prongs, and bumps, was no security to *Synthetoceras* when a new life of sudden changes confronted him. With him a long line of strange beasts quietly expired



ALL DRAWINGS BY MARGARET COLBERT



(Right) STRANGE, LONG-FACED PECCARIES once lived in Nebraska

(Opposite) A "conservative" of the Age of Horns: *Sphenophalos* may well have been an ancestor of the persistent line of North American antelopes, of which the pronghorn is sole survivor

CIRCUS
without spectators

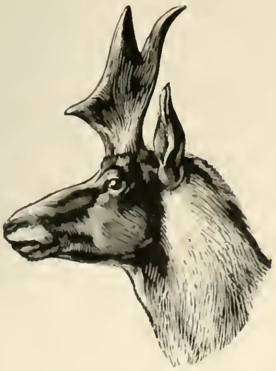
No human eye witnessed the parade of strange creatures in that age of superspecializations, but science reconstructs the surprising pattern from which our modern animals emerged

By Edwin H. Colbert
Assistant Curator of Vertebrate Paleontology, The American Museum of Natural History

For millions of years after the disappearance of the last dinosaurs and on through the long period during which archaic mammals were dominant on earth, the geologic history of North America, of the world for that matter, progressed in a steady and, one might say, comparatively placid fashion. Lands that were low and tropical when the mammals first began to flower were gradually uplifted to become high, grassy plains. Imperceptibly the mountain chains of the West came into being. The entire continent slowly pushed up and up until the landscape took on those features of hill and vale, mountain and plain closely resembling its present-day lineaments.

And with the implacable evolution of the continent toward its more modern form there were concurrent developments among the mammals, which had inherited this strange new world from their reptilian ancestors.

The mammals, it will be remembered, are the warm-blooded animals which generally give birth to living young instead of laying eggs and are able to nurse their offspring through earliest infancy. The importance of this chapter in evolution is evident when we realize that it concerns the ancestry of our most familiar four-footed animals of forest and plain.



At first changes were slow, as Doctor Simpson has pointed out in the two preceding chapters of this story. There was a long period of "experimentation" following the Great Invasion of more modern mammals into the New World, a period when Nature seemed to be trying out various models of animals, apparently in an effort to determine the forms most suitable for a continued existence in a fiercely competitive Scheme of Life. Many of the early experimental models were tried and many were found wanting, but out of the great melange of strange, primitive beasts which evolved between 40 and 60 million years ago during the earlier phases of the Tertiary period, some forms, more adequately fitted for continuation than their contemporaries, survived to give rise to the great mammalian faunas of later Tertiary times.

The later phases of the Tertiary period, notably the Miocene and Pliocene epochs, were pre-eminently the Age of Mammals. This was the time for the culmination of many lines of mammalian descent; it was the time when the earth was inhabited by hordes of beasts of different kinds and of high specializations. These numerous four-footed mammals, many of them of peculiar form and aspect, truly reigned supreme, for at that time there was not yet the unquiet and disturbing biped known as Man to contest their rule of the earth. They lived their separate but integrated lives unseen by the avid human eye. They marched and countermarched in imposing array across the face of the continent in processions of magnitude. They were the menagerie of an ancient circus without spectators.

These animals of the late Tertiary were for the most part wonderfully adapted to the environments in which they lived. They were suited to almost every conceivable "ecologic niche" of the late Tertiary world—that is, they were specialized to varied modes of life on the plain and in the forest, to grass-eating and to meat-eating, to burrowing and to climbing, to protection by virtue of their great size, and to escape by running. All of the exigencies of life on the land were met by the evolutionary development in these animals. Like the animals of our present-day world, these late Tertiary mammals had become modified to take advantage, each in his own fashion, of the varying conditions around them.

They were like the mammals of our present day world, yet unlike them. True enough, many of them were the ancestors of our modern types of animals and as such were intermediate between their earlier ancestors and their present-day descendants. They were distinctly and greatly advanced over the animals of early Tertiary times from which they had sprung, yet they were still sufficiently lower than their modern grandchildren to appear noticeably primitive to the modern eye. On the other hand, many of the animals of late Tertiary times were end products in themselves and had developed along lines that seem to us strange and bizarre; they were the rococo designs in mammalian architecture.

What was the world like in those distant days? Were not the inhabitants of an earlier land than ours strange and wonderful to behold? Let us project ourselves back through the mind's eye to a scene in the western part of North America of that ancient day—say some seven or eight million years ago, at about the beginning of the Pliocene epoch.

In those days the high plains of the West were not greatly different in appearance and development from what they are today. There were extensive rolling grasslands cut into mosaics by shallow streams, along which grew fringes of trees and small bushes. The climate was warm and fairly arid, perhaps without the extremes of temperatures that are so characteristic of that region today. Very likely the winters were considerably less frigid than our modern winters, so that there was in North America an environmental condition not unlike that of the modern African veldt.

Most apparent in the scene of that day, even as now, would have been herds of hoofed mammals that lived on the open prairie, and of all the later Tertiary mammals perhaps none were more markedly different from their modern counterparts than these grass-eaters.

Rhinoceroses in Nebraska may seem to be something of an anachorism to us, but there they were. Not the rhinoceroses of today, but heavy squat short-legged animals, ungraceful and almost hornless. It may be that these were water-loving rhinos, spending much of their time along the shallow watercourses of those ancient plains.

Drifting across the grasslands were herds of horses, —unmistakable horses, but horses in miniature. For these later Tertiary horses, though various, were all of pony size. Some of them were of the three-toed type, the persistent and conservative followers of their ancestors of ages long past; others were the more progressive single-toed horses, foreshadowing in form and structure their descendants of modern times.

Peccaries lived in ancient Nebraska, not the peccaries that we know from our modern tropical and subtropical America, but large, long-faced peccaries, many of them with large projections or bumps on their cheeks, so that they must have looked something like the wart hogs of present-day Africa.

If the rhinoceroses of later Tertiary times may be styled as "sawed-off," the North American camels of that age were just the opposite, the slim-jims of their day. These were greatly elongated animals, with stilt-like legs and giraffe-like necks, towering into the rarified upper strata of the available food supply. And though strange of form, these perpendicular camels should not be regarded as strange in their occurrence, for the entire heritage of these animals was peculiarly North American. Here they arose and developed, and it was only at a later date, in the great Ice Age, that the camels emigrated from their North American homeland to newer lands, finally to become extinct in the land of their origin.

Here also were the last of the oreodonts, a group of hoofed mammals that lived and developed through a major portion of the Tertiary period. They were unlike anything now living, rather short-legged animals, some of them as large as sheep. The head was remotely sheep-like, rather deep and without any horns or bony outgrowths; and they had four well-developed toes on each foot, and a long tail.

But strangest of all the varied grass-eaters of those distant plains were the numerous horned and antlered forms. In some of these animals evolution seemed to have "gone on a bender," for nothing like these animals should reasonably be expected outside the world of dreams or of delirium tremens. Here were deer-like animals with "horns" or "antlers" of a bewildering variety. Many had the usual pair of such structures at the back of the head above the eyes, in some cases curved in, in other cases curved out, in some cases directed backward, in other cases pointing forward; but others had prongs and points jutting out of all sorts of strange and unexpected places on their skulls, which gave them nightmarish aspects, to say the least. Our knowledge of these peculiar horned animals has been greatly augmented in recent years by the collections of the Frick expeditions of the American Museum—indeed, a whole new world of peculiar mammalian types has been opened up as a result of this work.*

This was an age of *three-horned* animals, of beasts which sported a single median horn in addition to the usual pair above the eyes. One of these triple-horned grazers, *Synthetoceras* by name, had two very adequate and ornate structures over the eye sockets and then, as if this weren't enough, he had an unbelievably long prong, forked at its tip, projecting up from the front of the nose. In addition he had a couple of small knobs on the sides of the skull. And then to supple-

---

**See* Childs Frick, "Horned Ruminants of North America," *Bulletin of the American Museum of Natural History*, LXIX (1937).

ment this array of points, prongs, and bumps, a pair of well-developed canine teeth or tusks peeped out from beneath his fleshy upper lip. Needless to say he was one of those end products of evolution, and with him a long line of strange beasts quietly expired. Which is our loss, for he must have been something to look at. Bounding along with his head up before the prairie wind on a stormy day, he must have looked like some sort of peculiar three-masted schooner with all of the canvas hauled down.

Another one of these unorthodox grazers had a third horn growing right out of the back of his skull, like the stern flagpole of a small ship. Our knowledge of this animal, known as *Cranioceras,* came about as follows: a score or more years ago, the late Dr. W. D. Matthew, then Curator of Fossil Vertebrates at the American Museum of Natural History, found in northwestern Nebraska the single median horn of this animal and recognized it for what it was. He named the animal on the basis of this fragment, and predicted what might be expected when the entire skull should be found. Many years later, not one but several skulls of *Cranioceras* were found by the Frick parties, and they showed a median horn, as Matthew had prophesied, but they also showed what Doctor Matthew had no way of guessing, namely the additional pair of horns above the eyes. Even so, this confirmation of Doctor Matthew's shrewd prediction indicates the depth of knowledge and perception possessed by that great paleontologist.

Of course not all of the horned animals were quite so outlandish as these three-horned fellows. Indeed, some of the horned grazers of that distant day were relatively conservative, and as might be expected these were for the most part the ancestors of persistent evolutionary lines. For instance, there was a large variety of antilocaprids, of which our modern pronghorned antelope is the sole survivor. Some of these early antilocaprids were rather deer-like, with branched "antlers" on their skulls, but others, although tending to favor the ornate in their horn development, were even then prophetic of the pronghorn. There were other horned grazers, too numerous to mention, but perhaps this gives some idea of what might be expected of these animals in North America during the Pliocene age, several million years ago.

It was an age of horns—even the rodents had them. In the late Tertiary deposits of the high plains there was a whole series of horned gophers characterized by transversely paired horns on the nose.

Grazing and browsing with the hoofed mammals on the open plains were the tusked and trunked mastodonts, the Tertiary forerunners (but not the ancestors) of our modern elephants. There were several kinds of these, most of them characterized by four tusks, two in the upper jaws—as in the modern elephants— and in addition two in the lower jaw, which was greatly elongated. All of these long-jawed mastodonts were peculiar, but perhaps the prize of the lot was the animal known as *Amebelodon,* the so-called "shovel-tusker," in which the lower tusks were not rounded in the orthodox fashion, but flattened to form broad scoops, enabling these animals to poke around in the mud and among shallow-water plants of the prairie streams for their food. In addition to the peculiarity of its tusks, the lower jaw of *Amebelodon* was unbelievably long, and one wonders how this animal negotiated hillocky ground without constantly ramming his lower tusks into the earth like a broken down wagon-tongue. At any rate, *Amebelodon* did exist, there are his bones to tell us so, and he was seemingly successful for a while. It is probable that the trunk of this animal was not round as is usual among the proboscideans or elephant-like animals, but flattened, a sort of elongated upper-lip,—which is really what it was.

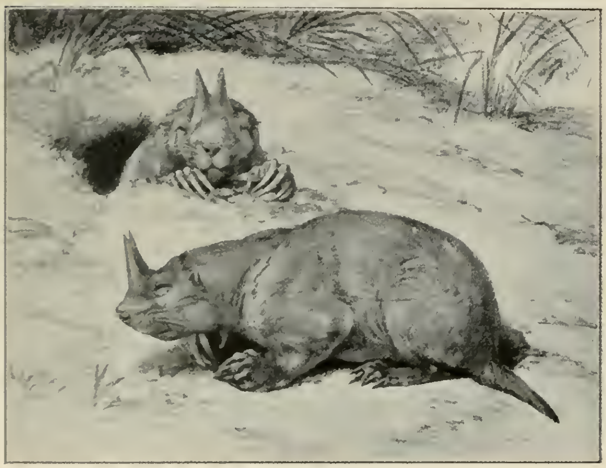
No picture of animal life is complete without the beasts of prey which live upon the grass-eaters. And there were many such hunters in Nebraska of long ago. But they did not show the bizarre developments so apparent among the grazers. Here we come into the realm of ancient dogs, some of them ancestral to our modern wolves and foxes, others of gigantic size —obviously the culminations of lines long in the process of evolution. Here were the late Tertiary cats, of different sizes but not so very different in form from our modern felids, except for those of the sabertooth variety, with their great, scimitar-like canine teeth. Here were the weasels and their ilk, the badgers and the skunks, the raccoons and all of the various lesser carnivores that found their living off the small rodents and other small fry which scampered along miniature runways through the grass roots, or sought protection beneath the soil in subterranean burrows.

Such was the Parade of Life long ago—a parade of forms both familiar and strange to the eye of modern man. In it were the ancient dogs and cats, the various gnawing rodents, the horses and other animals, marching toward a future of continued evolutionary development. But also there were in it the peculiar short-limbed rhinoceroses, the stilt-legged camels, the shovel-tusked mastodonts and the host of bizarre horned ruminants marching toward the oblivion of extinction.

Why should this be? Why should those delightfully strange beasts die out at a time when they seemingly were riding along so successfully on the crest of a wave of evolutionary development? Why did they disappear, to be succeeded in modern times by forms which to us seem by comparison so prosaic?

Perhaps it was the trend of evolution. The climate was becoming increasingly severe, the land was losing some of its long-established geniality. The lush life of the warm plains and the woodlands was over; a new life of fluctuating temperatures, of ice and of snow was in the offing. Conditions were changing, and changing at such a rate that these highly specialized animals with their shovel jaws, their short legs and long legs, and their varieties of horns and prongs could not make the adjustments necessary to survive the gathering changes, so they gradually died out, to make way for what we are pleased to call the "modernized" types that succeeded them. It is the old, old story that is told time and again in the record of the rocks. Only the fit survive, and when the environment begins to change, the fit are those which can change with it or adapt themselves to the new conditions that are being established. The highly specialized animals, no matter how well organized they may be for existence under the old conditions, must pass into the limbo of the dead if they cannot meet the stringencies of new conditions.

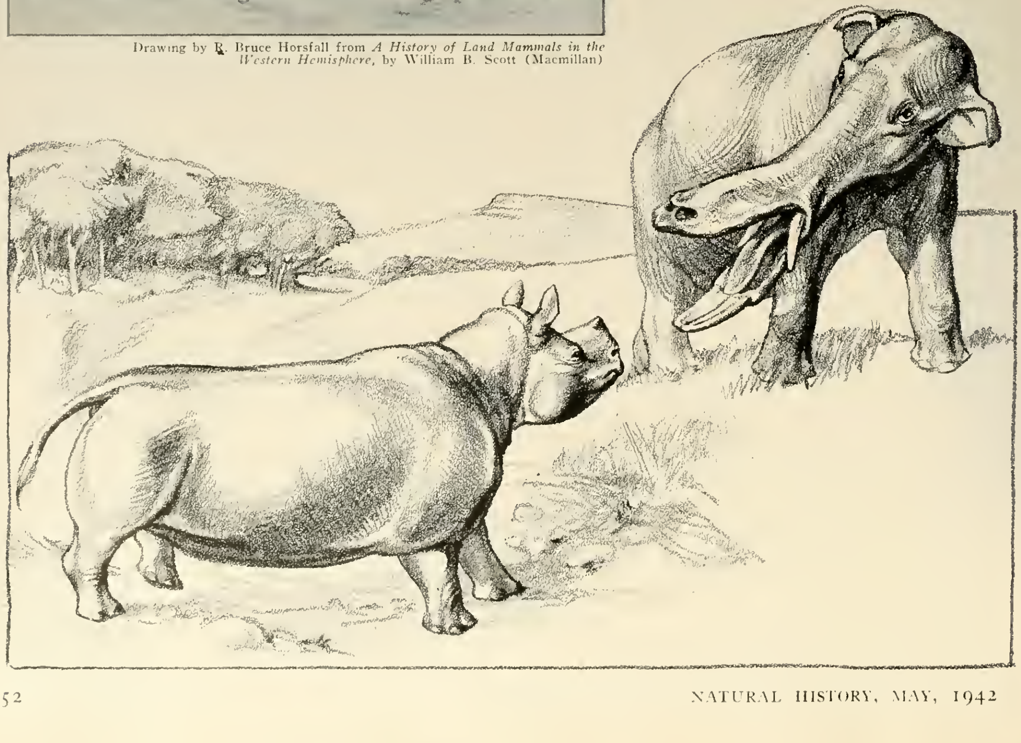
So it was that numerous denizens of America succumbed in the final stages of the Tertiary period. They disappeared before a new horde of beasts—a horde that came in with cold winds from the north, with the ice and the snow.



Drawing by R. Bruce Horsfall from *A History of Land Mammals in the Western Hemisphere*, by William B. Scott (Macmillan)

Even the rodents had horns. Transversely paired horns on the nose were characteristic of the late Tertiary gophers that scampered over the western high plains of North America

(*Below*) Nature's long period of "experimentation" included a squat, "sawed-off" rhino and a mastodont whose peculiar flattened tusks distinguished him as the "shovel-tusker"



An AMERICAN comes back

By BEN EAST

Once hunted to the threshold of extinction, the upland plover begins to lift his strange rolling call again in western pastures

ALL PHOTOS BY THE AUTHOR

It is more difficult to photograph a bird than to shoot it—and easier on the bird

His home in the old days was on the open prairies, in the rolling grassy fields, the dry meadows. That's why they called him the prairie plover, the prairie dove, the hillbird, the prairie snipe, the pasture plover,—and even "quailie," most affectionate of all his titles.

It is there, on the prairies, the hills and pastures, that the upland plover, a native American once condemned to extermination, is making his slow comeback.

In the beginning he was an abundant bird from the open fields of Cape Cod to the wide prairies of Saskatchewan. There was a time, birdmen relate, when this tall plover of the mellow voice was as plentiful in New England as the meadowlark, when he haunted the open fields of Minnesota in countless thousands, when the broad prairies of the West knew his kind in flocks the like of which no gunner of this generation has ever seen. In those days every grassy field, every reach of prairie in his far-flung range sheltered a nesting pair or two of upland plovers.

Then the market hunters turned their guns on this tall shore bird who shuns the shore, and the days of his primitive abundance came swiftly to an end.

No one will ever know, apparently, the details of how the market gunners slaughtered the upland plover for trade. No one will ever be able to fix exactly the toll they took.

The records are sketchy and incomplete, the available evidence fragmentary. The men who shot for market in those "good old days" kept few accounts. Of those who did the killing and might supply the story firsthand, few are left alive today. The plover harvest followed close on the heels of the pigeon harvest. It was as good as finished a decade or so before the century turned.

But here and there we come upon half pages of the story. And all we learn points to a great slaughter.

We know the kills were heavy. We know plover were shipped to the game markets of the big cities by box and barrel. We know the flesh of the prairie snipe brought high prices and was in good demand. The gunners met the spring flight on the prairies of the West, and they shot again when the birds began to move south in late summer. It was a "popular method" to drive a team and buckboard within gun range of the flocks when they were too wary to be approached on foot.

"About 1880, when the supply of passenger pigeons began to fail," Forbush sums up the story, "the marketmen, looking about for some other game for the table of the epicure in spring and summer, called for plover. Then the destruction of the upland plover began in earnest."

The guns took their toll, for market and sport alike. There was in that day no law to protect shore birds or other wildlife. We had plenty. It would last forever. If it didn't, let tomorrow look to itself. At the same time cultivation and drainage and burning reduced the prairies where the quailie nested. So its ranks thinned, and by the turn of the century there was good reason to believe its death warrant had been signed. There was little reason to hope that the upland plover would have the chance to come back.

What Dr. Thomas Roberts had to say of the situation in Minnesota applied to conditions over all of the plover's original range. "Here and there an occasional breeding pair may yet be found," he wrote, "but they are lonely occupants of the places where their ancestors dwelt in vast numbers."

By 1910 few birdmen would have ventured an optimistic prediction for the future of the quailie.

"We know of few places where it breeds now and its voice on migration is seldom heard," said Barrows, writing of the upland plover in Michigan in 1912.

In my youth, 30 years ago, the bird was entirely unknown in his old haunts in the clover fields and pastures of southern Michigan. As a boy I never saw an upland plover or heard the sweet trilling cry of one roll across the June meadows. Killdeers we saw aplenty on the wet lowlands. Larks were abundant in the hayfields, the bobolinks in the marshes. The bittern walked the ditchbanks, and we knew him as the thunderpump. The great blue heron waded the ponds and lake margins, tall and solemn and deliberate. Flickers and bluebirds nested in our orchard, and barn swallows tormented our farm cats, swooping out from their mud lairs beneath the dusty barn rafters. Birds we knew of many kinds, but not the quailie. As a farm lad I never heard even his name.

Later I came to know of him. I heard something of the bloody record of the market gunning. But even then, no more than 20 years ago, I never hoped to see this plover nesting in our meadows again.

Rumors of return

Then the word began to get around that he was coming back. A pair was seen here, another there. He was still persecuted in his wintering grounds on the broad pampas of South America, where he has unfortunately inherited the reputation of the lost Eskimo curlew as a table bird; and to this day he is hunted relentlessly for market through the months of the northern winter. But the bird was showing up once more in his old haunts in the midlands of the United States in May and June.

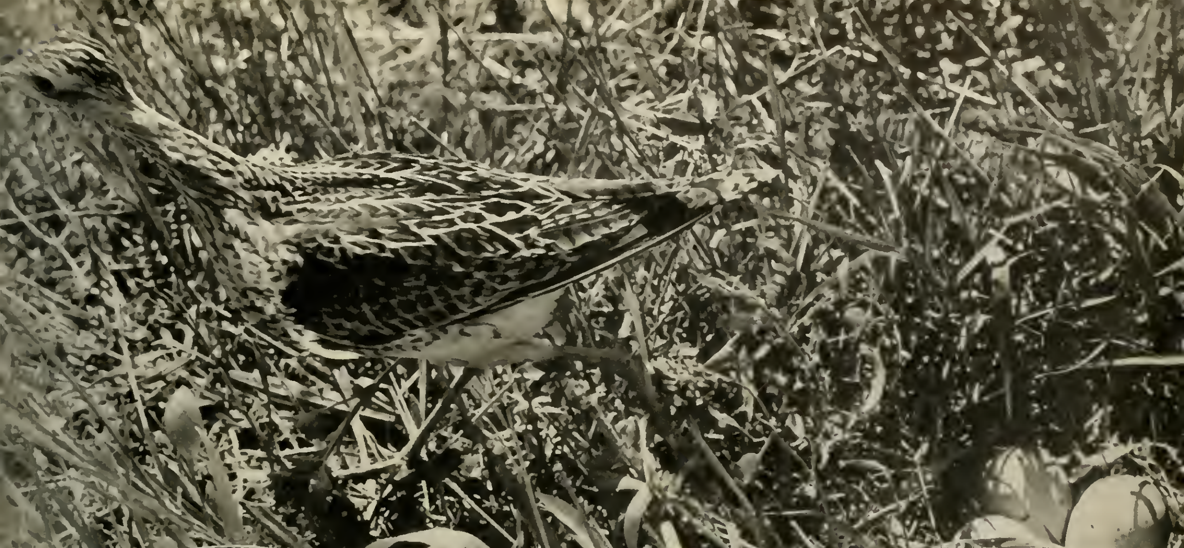
At last there came a red-letter day when a pair of upland plovers was reported nesting in a county in north central Michigan. It was the first nesting record for the state that had ever come to my attention.

A camera-hunting friend of mine, Walter Hastings of the Michigan Department of Conservation, visited that nest, put up his blind in the short grass a few yards away and made a film record of the hen plover on her eggs. No bird pictures thrilled me more than those. This was a bird I feared we might never see again, a bird which had stood on the very threshold across which heath hen and passenger pigeon and Eskimo curlew passed beyond recall.

A few more springs passed and word came to me of an upland plover nest within 20 miles of my home. I packed my cameras and searched out the farm with high hopes. But I came back without pictures.

The nest was there, and the two plovers circled around us and set the field ringing with their sweet trilling alarm cries. But while we stayed in the vicinity of the nest they refused to come near it. We set the camera on a tripod and ran a silken line back 50 yards to a hiding place beside the fence, but the birds were afraid of the strange black box on three legs, and we gave up finally, unwilling to risk chilling the eggs by keeping the hen plover from them longer.

For four years after that I saw no more upland plovers, although scattered reports indicated a steady gain in nesting records in our part of the country. More and more frequently birdmen saw the quailie in the summer fields. More and more the farmers of southern Michigan became familiar again with the strange rolling call that is so like the trilling of a tree toad, although few of them could name the long-legged, dun-colored bird that made it.



"GONE the way of the heath hen, the passenger pigeon, and the Eskimo curlew," was the sad verdict of bird lovers a few decades ago. But these pictures, taken more than 50 years after the ruthless market slaughter of the eighties, reverse the decision. *(Above)* A mother plover leaves her nest just as the camera clicks, revealing her share in the future. Unlike countless thousands before her, she lived to see her chicks hatch out —within 50 feet of a gun club's firing line

(Left) THE bird's protective coloration is excellent

ONCE AGAIN the sweet trill of the upland plover echoes across our meadows. Its survival depends on the observance of wise conservation laws

(Below) SOON the mother plover lost her fear of the photographers and played her part with accustomed ease

Then a conservation officer friend called me one day to say he had word of a strange bird nesting in the short grass on the grounds of a gun club in the outskirts of my home city. Before he had finished describing the tall bird and her cries I knew we had located another quailie nest.

It was an odd site the pair had picked—midway between the two houses of the skeet field, no more than 50 feet in front of the firing line where the gunners stood.

Perhaps that is why the hen plover was so lacking in the normal wariness of her kind. Having grown used to the thundering barrages of the skeet field, she may have cataloged us as quiet and well-meaning visitors by contrast.

The grass was short and sparse. Midway in the field stood a clump a little taller and thicker than that around it. There the plover nest was hidden. I inched my way out to the clump and no more than two yards distant I stopped and searched the tangled grass jungles for a sign of the brooding bird. She was there somewhere, I knew, a part of the light and shadow that wove its tangled pattern over the ground. But try as I would I could not make her out. There were no bird outlines there. Only the waving grass stems, and beneath them the tawny, black-and-gray-and-brown carpet of the dry field.

That perfect mimicry of a nesting game bird, hidden beyond belief among dead leaves or rushes or grass stems, is forever a fresh marvel to me. It is incredible that plumage can blend so indistinguishably into earth, that animate and inanimate can make so natural a union.

They seem to realize their advantage, too, those dull-robed females of field and thicket. Some instinct appears to warn them that safety lies in staying still, that so long as they are motionless the visitor is sure to pass them by. Else where do they find the courage to face the animal they dread most in all the world, no more than arm's length away, as steadfast and unmoving as birds of stone?

I gave up looking for my plover finally and shuffled a step or two into the grass clump. She flushed then, all but beneath my feet. She did not take wing. She ran off through the grass, piping her querulous complaints. A hundred feet away she found shelter in taller grass beyond the edge of the gun field, and we lost sight of her. But we could follow her by her low, anxious alarm notes. She circled us, calling anxiously, while we worked as quietly as we could beside her nest.

It was a deep bowl in the ground, lined sparingly with dry grass, holding the usual clutch of four eggs, pale buff in color, speckled lightly with warm brown. Above it we arranged two cameras on tripods. From the shutters we ran lines back to a low trap shelterhouse 20 yards away. There we waited for the quailie to come back.

We had only a little time to wait. She had almost no fear of us. The two cameras, so near to her nest, bothered her at first, but little by little she drew nearer to them, studied them carefully and dismissed them as some new but harmless part of the landscape. She walked up slowly, a few cautious steps at a time, craning her long slender neck this way and that, seeming more curious than afraid. Within a yard or two of the nest, she stood for a brief moment to make a final survey of the cameras. Then she crouched down among the grass stems and slipped back to her eggs like a swift shadow. Through the binoculars we could make out her head, lifted above the nest, turning warily from side to side as she studied the lenses that stared down at her and at the same time she kept watch across the field to make sure no new danger threatened.

One after another we pulled the strings. When we moved out to reset the cameras she kept her place until we were almost beside her. Then she ran off, more reluctant than alarmed. This time she did not bother to seek shelter in the tall grass. She circled in plain sight, and when we turned back toward the shelterhouse she came boldly toward the nest. Before we were in our places she was in hers, lost to sight in the grass clump, calmly covering the four buffy eggs once more.

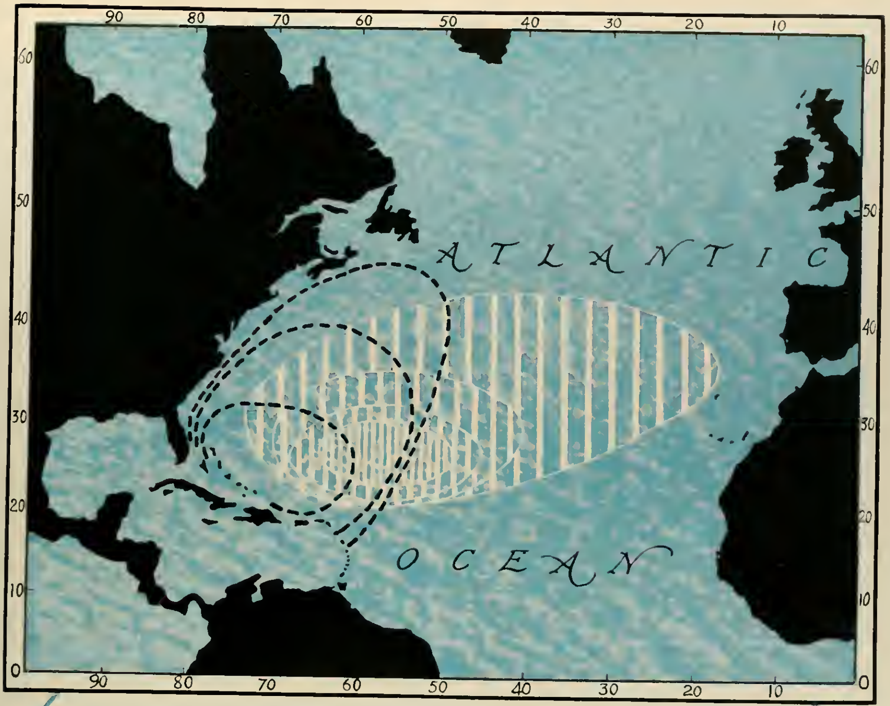
Before the week was done, despite the thunder of the skeet guns, she carried out her mission. The following Sunday morning the nest was empty, and fragments of broken shell told that it had not been raided. Somewhere in the tall grass of the near-by fields, I hope, the hen plover was leading four brown chicks.

The necessary laws

I have not seen the nest of an upland plover since, but I am well content. It is enough for me that the quailie is coming back, that I have been privileged to see and photograph this tall plover nesting once more in our southern Michigan meadows, that its mellow call is heard again in early June in many places where it was long absent.

Years from now, if all goes well and we accord this gentle bird the treatment it merits, we shall be able to say of the pasture plover: "This one we saved. For once necessary hunting laws were enacted in time."

To some small degree, maybe, that will lessen our shame that in the case of the pigeon and the heath hen and certain others we did not do as well.



The migration of American eels is shown by the dotted lines, that of European eels by the white areas

The itinerant EEL

By PAUL BULLA

From the weed-choked Sargasso Sea, newborn eels wriggle thousands of miles to their ancestral homeland—inland in North America or Europe, depending on their parentage. How do they do it?

OFF the North American continent, southeast of Bermuda and northeast of Puerto Rico, lies a vast tract of slowly swirling water known to mariners as the Sargasso Sea. Here, according to song and story the Gulf Stream is born, and here far below the weed-choked surface is the breeding and spawning grounds of our own fresh-water eel.

Here these strange fish have their rendezvous. In this sea within a sea they are born, and here, after years spent in far places, they return to reproduce themselves and die, for no spent eels have ever been seen, and adult eels have never been known to run upstream.

Of all the fish known to mankind, few have a more remarkable life history, and none have puzzled scientists for so long a time as have these snake-like denizens of the rivers and lakes of Europe and America. Down through the ages they have been a food delicacy in the European and Mediterranean countries, but centuries passed before their migratory habits and method of propagation were explained. Each autumn uncounted numbers of these slimy creatures moved downstream to the sea, where many were caught in the nets of fishermen awaiting their migration. But great numbers avoided this fate and disappeared never to return.

In the spring and summer of each succeeding year, tiny eel-like creatures appeared from somewhere in the vast ocean spaces and swarmed along the coast of Europe and through the Straits of Gibraltar into the Mediterranean. Later they entered the fresh-water streams and rivers that ran down to the sea, penetrating to the interior where they grew to maturity. Confusion further confounded the minds of scientists and simple fisherfolk alike by the fact that eggs of unborn eels were never found in the bodies of adults, and males of the species were never seen.

Many strange theories were advanced in explanation of how they were produced, ranging from spontaneous generation to the transformation of horsehairs into little eels. Aristotle, in the fourth century B. C., held that eels were born from earthworms, which were in turn produced from mud or damp soil. The early Greeks, failing to find spawn or male reproductive glands within the eels, named Jupiter as the father, as all children of doubtful parentage were ascribed by them to this god.

Pliny the Elder, great Roman naturalist and author, declared with conviction that eels had neither masculine nor feminine sex. In accounting for their multiplication he concluded that they rubbed themselves against rocks, and the pieces scraped from their bodies came to life as little eels. He dismissed the subject as a matter for further controversy with the laconic statement that "they have no other mode of procreation." With the acceptance of such beliefs it is small wonder that centuries elapsed before such theories were dispelled and such superstitions overcome.

It was not until 1777 that the ovary of the eel was first recognized by Carlo Mundini, a professor of anatomy at the University of Bologna, thus definitely establishing a female sex. Ninety-five years later Reinhold Hornbaum-Hornschuch announced the discovery of a male individual, and the enigma that had endured for over 2000 years was on its way to being solved.

But while these discoveries partly answered the riddle of their existence, where they came from and how they were produced still remained a mystery. It was left to a German named Johann Jakob Kaup, in 1846, to find in the sea a small ribbon-like fish with a tiny head. Curious as to its species, he took it home and placed it in a bottle of alcohol. After labeling it *Leptocephalus brevirostris,* a name which exceeded the length of the specimen itself, he left it there to be forgotten.

Half a century passed before the subject emerged from the obscurity into which it had been relegated. On a day in 1896 two Italians, Gracci and Calandrucci, found one of Kaup's little fish in the Mediterranean, but one much larger and more fully developed. This they identified as the leptocephalus or larva of the edible eel that inhabited the streams of the European continent. With that beginning the stage was set for a Danish scientist named Johannes Schmidt.

As director of the Danish Commission for the Exploration of the Sea, Schmidt sailed in 1906, on the first of many subsequent expeditions, to locate the breeding and spawning grounds of this specter of the deep. For fifteen years he towed nets up and down the Atlantic, taking specimens of leptocephali from the English Channel to Chesapeake Bay, and from Greenland to Puerto Rico. Over this vast area he collected and correlated sizes of eel larvae, carefully noting the latitude and longitude in which they were obtained.

He reasoned that the larvae were growing as they moved from the place in which they were spawned toward the coast and their fresh-water homes. It followed therefore, that the smaller the larva found in any part of the ocean, the nearer such specimen must be to the place where it was born. After years of tireless effort he was able, through this method, to fix the breeding and spawning grounds of the European eel (*Anguilla vulgaris*) and the American species (*Anguilla rostrata*) within the latitudes 20 to 30 degrees north, and longitudes 60 to 78 degrees west. He further established the fact that the European beds overlapped those of the American species.

But this discovery uncovered but one phase of the life cycle of the eel. During the period of growth in the waters of their home continent, both males and females are a uniform green to yellowish-brown above, shading to a pale dirty white underneath, and are called "yellow eels." When the migratory instinct asserts itself at the breeding stage, which is in the autumn when they are between the ages of seven and fifteen years, the sides of their bodies take on a metallic sheen and their backs become a deep black. This is their breeding dress, and they are then known as "silver eels."

Upon assuming this dress certain other marked changes take place in the females. Their snouts become sharp, the eyes larger, and the pectoral fins, just back of the gill slits, more pointed than usual. Although they have been voracious eaters all of their lives they cease feeding at this time and, leaving the lakes and rivers in which they have lived, move downstream to the sea. But while these visible changes have been taking place, it is not until after they have reached salt water that the ovaries mature. In fact no perfectly ripe female eel and only one ripe male has ever been seen. Upon arriving in the bays and estuaries of their home shores they are joined by the mature males that have been living there, and together they start the journey back to their birthplace, over 2500 miles distant.

It is not known how far below the surface they swim, but somewhere beyond the continental shelf they pass from the range of observation. Neither is it known how long it takes them to reach their destination, but it has been estimated that the eel requires about six months to make the crossing, swimming at the rate of one-half mile an hour. As the migration from the European continent begins in early autumn, and spawning starts in early spring at the breeding grounds, this estimate of the period of time for the trip seems to be justified.

Upon arrival at the breeding grounds, the European species find they must share it with their American cousins whose beds overlap their own, but extend westward from it. From Labrador southward to Panama and the West Indies, the "silver eels" from America have journeyed to the rendezvous in from one to two months after reaching salt water. Hundreds of fathoms below the seaweed-clogged surface of this tropical sea the eggs of both species are spawned; the females producing from five to 20 million tiny eggs, transparent and almost colorless.

Spawning begins in late winter or early spring, and a week or so after fertilization the eggs are hatched, and larvae of both species begin life with a length of about one-fourth inch. Ribbon-like in shape and so transparent that newsprint can be read through their bodies, they float for a time from 600 to 900 feet below the surface. Later they rise into the upper layers of water and slowly move northward. Reaching the latitude of Bermuda, a separation occurs. The larvae of the European species move eastward on the long journey back to their native shores, while their tiny American relatives turn toward the coast line of America.

During their first summer of life the European larvae are found in the western Atlantic. By the second summer they have reached the central Atlantic, and by the third they have arrived off the coastal banks of Europe. During their two and one-half years in the ocean they have attained a length of two to three and one-half inches, but still retain their flat, leaf-shaped larval form. They are now faced with a new way of life and must be prepared to meet it. In the course of the autumn and winter a metamorphosis takes place. They cease feeding, lose their larval teeth, shrink in depth and length, and become elvers, or little eels. While they are shaped like their parents in miniature, they are still transparent, and so are known as "glass eels."

Our American eel has a shorter larval history. Here again the timing is perfect, for it reaches its home shores and the elver stage of existence in about one year.

After the transformation from larva to elver, the females of both species ascend the fresh-water streams of their native land to live their lives in the interior until the moment when the migratory instinct drives them back to the sea. In these journeys upstream they use pipe lines and sewers and clamber over falls and surmount dams to reach their destination. The males however, remain in the brackish waters of lagoons and estuaries, where they grow to maturity and await the downstream migration of the females.

As eels have been found in ponds having no outlets or inlets, it is believed they will travel overland to reach these oases, choosing nights when the grass is damp for the journey. As there is no evidence to establish this presumption, their presence in these isolated waters is still something of a mystery. They are also at home in high as well as low altitudes, having been found in Swiss lakes 3000 feet above sea level.

All eels in the headwaters of large streams are found to be females. As a rule they lie buried by day in the muddy bottoms where there is still water, and venture abroad to feed at night. Being scavengers and omnivorous, they will eat almost any available food, either living or dead. They have even been known to eat their own kind.

Female eels average from two to three and one-half feet in length, but have been known to reach four feet and weigh as much as sixteen and one-half pounds. Males average around fourteen to eighteen inches in length, but never grow larger than two feet. The vertebrae of this fish mark the only difference between the American and the European species: the former have an average of 107 segments, while the latter averages 114.

Differing from their salt-water cousins, the lower jaw of both species projects beyond the upper, while the large mouth gapes back to a point even with or somewhat behind the eyes. On the side of the neck are gill slits with upper corners on a line with the center of the base of the pectoral fins. A single fin, soft and without spines, extends along the back, around the tip of the tail, and forward on the underside of the body. There is no separation into dorsal, caudal, or anal parts. After the third or fourth year of life, eels develop small scales that are embedded in the skin. These are covered with a coating of slimy mucous, which has given rise to the simile, "as slippery as an eel."

Perhaps the most intriguing phase of the life cycle of this unusual fish is that neither European nor American elvers have ever been known to appear off the shores of any country but their own. This fact immediately presents two puzzling questions that challenge the imagination.

1. What causes the immature larvae of the European species to move eastward from the spawning grounds, while its American cousin works toward the west side of the Atlantic?

2. How does it happen that the timing is perfect for both species to reach the elver stage within a few months after arriving off the coast of their home continent?

These may be answered in part by the difference in their individual larval histories.

While the European larva requires from two and one-half to three years to reach the elver stage of development after life begins, the larval stage of the American species is terminated in about one year. This time element not only acts to keep the two species distinct, but makes it practically impossible for either to survive in waters other than their own after metamorphosis takes place.

Should the larvae of the European eels move westward they would reach the American coast line still in an undeveloped larval stage; while the American species traveling westward would reach the elver stage somewhere in the western Atlantic when the time arrived for them to seek fresh-water retreats.

A geographical cause for their distribution is advanced by Doctor Schmidt, who points out that the center of production for the American eel lies farther west and south than the center of the European beds. These, together with the movement of the ocean currents as an aid to the journey in the early stages of larval development, must be considered as causes directing the two species each to its own side of the ocean.

While much has been learned of the habits of these sluggish, sedentary fish, since the turn of the century, much remains unexplained.

With a singleness of purpose and an unerring instinct that has confused scientists, untold thousands have deserted their home waters each autumn to seek adventure in a tropic sea and to keep their rendezvous with death. Weak and immature, their progeny is cast adrift far from their native land and, unguided, these feeble swimmers travel a road over which they have never journeyed, to reach their home continent.

Truly, the eel is one of the greatest of marine mysteries.

The largest known Crocodile

By BARNUM BROWN *Curator of Fossil Reptiles, The American Museum of Natural History*

Today North America has but a single species of crocodile. Past ages beheld many and varied forms of this tail-slashing reptile, but none was as huge as the 45-foot Texas giant which competed with the dinosaurs

It is huge! Colossal! Gigantic! But even these superlatives fail to give any mental picture of the enormous prehistoric crocodile head recently found in Texas.

The American Museum-Sinclair Expedition of 1940 discovered this huge fellow in the "Big Bend" region of southern Texas just north of the Mexican border. Other bones in the same rock show that dinosaurs new to science were fellow countrymen of this great reptile some 70 million years ago in the land that is now Texas. Some of these dinosaurs were likewise of gigantic size.

When discovered, the remains of the crocodile were only an incoherent mass—large broken sections of the skull and jaw, jumbled together and completely embedded in hard stone. It took eight months of continuous, difficult work in the laboratory for Roland T. Bird to chisel them out and prepare *Phobosuchus* for study and exhibition.

With a complete lower jaw of a crocodile or alligator it is possible to compute quite accurately not only the length of the skull but that of the entire animal. The estimated length of the body is based on the ratio of one foot of body to each inch of mandibular tooth space, a ratio which is fairly constant among living crocodiles. By this reckoning, the huge crocodile, when alive, would have measured more than 45 feet in length. As a further check, approximately the same length is computed by comparison of the length of the single existing vertebra (fourth dorsal) with that of the similar bone in the modern crocodile.

The beast could open his mouth three feet, disclosing large, round teeth, several of which were five and six inches long and two inches in diameter. As restored, the skull is six feet long and three and one-half feet wide at the back. A close approximation of its entire form is possible, because we have almost the whole left side of the lower jaw, part of the right side, both sides of the snout, and the front of the head. The surface sculpturing of the exhibit is based on the modern crocodile.

The first known specimen of this kind was found in Montana in the Judith River beds, probably of the same period. This consisted of two large vertebrae, ribs, pubis, skin plates two inches thick, and a few other fragments. But previous to our discovery we had no idea of the size or form of "Phobo's" skull, and it seems most fitting that this biggest "croc" skull should be found in Texas, our biggest state.

Crocodiles are of world-wide distribution throughout the tropics and subtropics, and in past ages they were far more numerous and varied than at present, many kinds having dropped along the wayside. Today North America has but a single species of crocodile and a single species of alligator. The crocodile is readily distinguished from the alligator by its more pointed head and by the way the fourth pair of mandibular teeth fit into notches on the side of the snout—as indeed they do in this fossil skull.

Within the memory of man there were alligators in Florida that measured fourteen and fifteen feet in length, but now a twelve-foot specimen is rare. The American crocodile is still smaller. The Asiatic marine crocodile is the largest living form. Some specimens reach a length of 33 feet, but their skulls are pygmy when compared to this fossil giant from the Rio Grande.

Lush semitropical vegetation covered a region rich in rivers, marshes, and lakes when our giant croc lived in the Big Bend country. Hordes of duck-billed, horned, and armor-plated dinosaurs as well as prehistoric turtles inhabited the shores. There were doubtless extensive woodlands, too. And the largest known fossil tree, measuring fourteen feet in diameter, is from this region. Climatic conditions evidently favored the huge sauropod dinosaurs here long after they had died off in the northern United States, where their remains are better known.

In the thin layers of ancient lake deposits encircling the Chisos Mountains there are literally thousands of dinosaur bone fragments. Strange to say, there are rarely any connected parts of skeletons. Having seen this gigantic crocodile, one cannot help playing with the idea that he and his kind may have been responsible for much of the breakage among the dinosaur bones.

Today this region is one of wild, picturesque beauty, semidesert in character but sparsely settled with occasional cattle, goat, and sheep ranches, miles apart. The entire area is dominated by the jagged igneous peaks of the Chisos Mountains, approximately 8000 feet high on the Texas side of the Rio Grande, and by the higher Del Carmen range on the Mexican side.

Steps are now being taken to make this Big Bend region one of our great National Parks—in fact, an International Park, for the Mexican Govern-

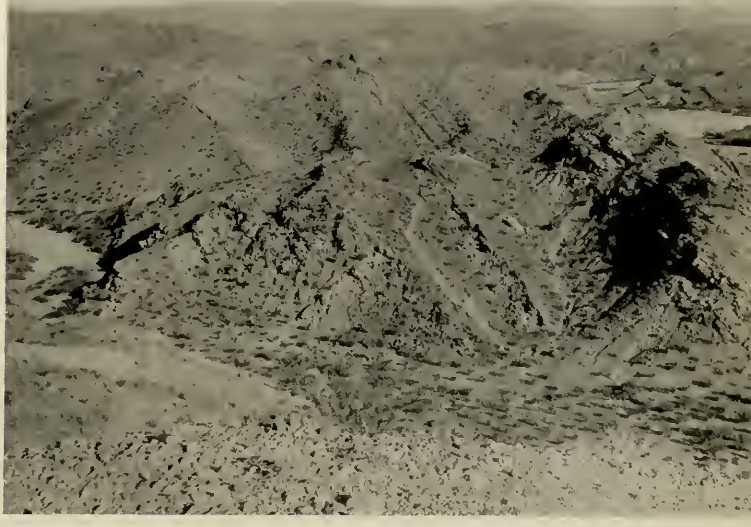
A THREE-FOOT YAWN! Barnum Brow *(left)* records Phobo's measurement assisted by Roland T. Bird, who restore

AMNH photo by Charles H. Coles

ment proposes to set aside a similar area that will connect with it south of the Rio Grande, forming an international playground.

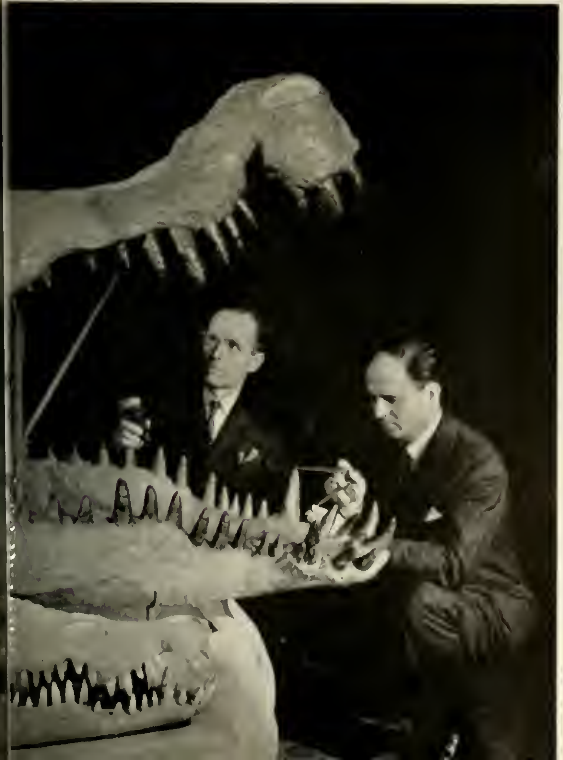
The Mexican side is rich in cave dwellings of prehistoric Indian peoples dating from the Basket Makers. In the Mexican villages along the Rio Grande, particularly in Boquillas, one can find Mexican food at its best. Historically, many fascinating episodes have taken place on this border region. It was at Glen Springs that one of Pancho Villa's marauding contingents crossed the border, and just south of the Rio Grande is one of the oldest settlements in North America.

Both the Mexican and Texas parks of this area will be unlike any of our other great parks. The region is fascinating to the traveler who can carry his own accommodations and water, and in the wilder places the adventurer may always have the lure of finding some new form of ancient life such as our champion crocodile, *Phobosuchus*.



ITS HOME was fittingly in our biggest state. This arid region in the Big Bend country is typical of the beds in which *Phobosuchus* was found. The trail was made to remove other fossils; one of which is visible at bottom

the skull, and Erich Schlaikjer, paleontologist. Phobo's skull dwarfs a modern crocodile's *(below)*. The American Museum-Sinclair Expedition's prize took eight months of reconstruction



WHEN *Phobosuchus* lived in southwestern Texas, vegetation was semitropical and luxuriant. Today only heavy rain changes the dry Banta Shutin Gorge into a river

Photos by R. T. Bird

CAMPING ON ANCIENT TRAILS

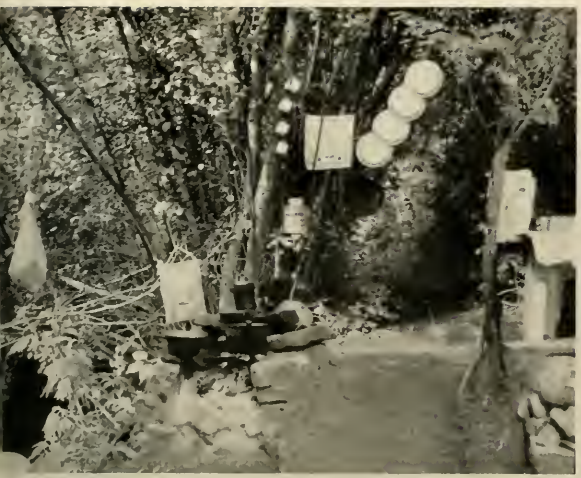
By N. C. NELSON

Curator of Prehistoric Archaeology, American Museum of Natural History

HOME is where the diggings are good. The Museum's last small tent proved a boon when the idyllic Indian summer yielded to daily thunderstorms and snow

IN THE TOWERING CLIFFS above the camp lay the caves which were occupied by Indians in early historic days. These two joined behind the massive pillar

All photos by the author



Beside the clear, cool waters of Sage Creek in south central Montana. No camp ever seemed more promising—for two days. The author's wife managed to outwit the pack rats by hanging the sack of potatoes by a wire *(left)*

The human side of an expedition to explore the caves of the vanished buffalo hunters of Montana, and how their unwritten history is being pieced together

Camp life is normally nothing new to a museum curator. It is part of his job and is accepted seasonally as a matter of course. But, the times being what they are, it was somewhat of a surprise after softening up in the Museum laboratory for fourteen years suddenly to be sent to the Rocky Mountains to dig out some promising Indian caves.

From all accounts it looked like a lark in paradise. The locality to be worked was well away from centers of white settlement on the sparsely populated Crow Indian Reservation in southern Montana. In addition the place was well up a mountainside, suggestively cool and comfortable in contrast to the scorching summer heat of New York City. The caves themselves were in the walls of a picturesque canyon drained by a fine cool stream lined with trees and bushes. The best time of the year, as vouched for by both local residents and several experienced fellow workers at home, was September and October, which form part of what is usually a long idyllic Indian summer. In short, in the words of the colleague who selected the caves the year before, "If Nelson doesn't have a good time, it will be just his own fault."

(Below) **The work begins**, a strenuous task involving the careful examination of over 100 tons of floor debris

How to outfit under such beguiling circumstances seemed at first a problem. The preliminaries were easily solved, however, for when I came to look in the storeroom for camping paraphernalia, all I found was a 6 x 6 foot silk tent and a single thin mattress. The rest had been taken by other members of the staff who had previously departed for Mexico and South America. To be sure, there remained also one decrepit old folding cot; but even if not a luxury, to take this meant buying another for Mrs. N. This thought was a trifle painful, because with limited funds and promising archaeological prospects the obvious thing was to outfit lightly and thus save money for excavations. Well, why not sleep on the ground? The cot was too long for the tent anyway. And so I took my own lightweight sleeping bag—once carried on my back for several hundred miles—and Mrs. Nelson was resourceful in improvising something for herself.

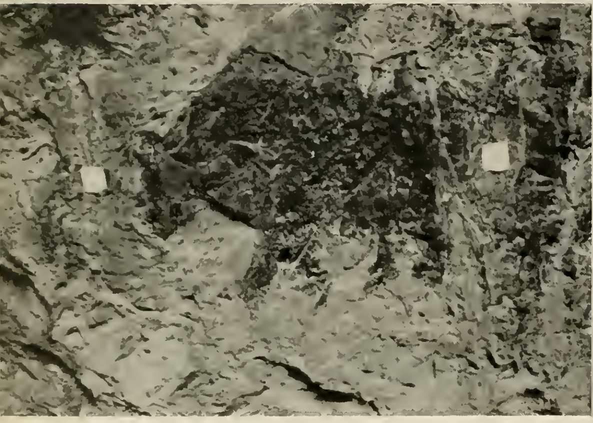
On August 10th, with the help of Mr. Oscar Lewis and other Museum friends from Billings, we pitched camp in the shade of a birch and chokecherry thicket within a few feet of the clear, cool waters of Sage Creek. No camp was ever more promising. The altitude was about 5000 feet, making us at first a little short of breath. But the noon temperature in the shade was only about 85 degrees, and the refreshing mornings saw it down to 44, low enough to make us enjoy the campfire. One of the two large caves for which we held permit from the U. S. Department of the Interior was visible in the towering cliff directly above us, and the other was less than a mile away.

Work began immediately and, except for the wily pack rats which stole everything they could carry away, all went well for two whole days. Then, on the 12th, the seasonal, almost daily, thunderstorms began. They never let up until September 7th, when they ended in a heavy snowstorm! And this latter, while of course "unusual," was no accident, because before we left for home at the end of September we experienced two more such snowstorms, one of them rather devastating. Incidentally, as if for good measure, the thunderstorms, which had a way of descending a little before supper was ready—drenching everything, including our enthusiasm—were interspersed with just ordinary rainy spells lasting from 24 to 36 hours. It is to be admitted that we could easily have escaped all these inconveniences of weather by moving into a cave; but the task of carrying wood, water, and outfit some distance and up 100 feet or more seemed too much. Besides, had we not been assured of "fine weather"? Still, we have decided that next time we go camping in Montana we shall bring winter garments, a big substantial tent, rubber boots and slickers.

But let it not be supposed that mere camp problems seriously interfered with archaeological pursuits. Work in fact went on in comparative comfort in the all-too-dry caves. Only once were we actually compelled to leave camp and seek shelter at a neighboring ranch house.

The earth of a once inhabited cave is sifted for small objects such as beads that might otherwise be overlooked

Material is removed layer by layer, because what is deeper is older. Here, however, the relics were at one level



Wall painting of bison, indicating that the natives respected the animal which civilization almost exterminated

Vestiges of an early fireplace can be seen where a dark stripe is exposed at the far end of the section above

In the walls of Sage Canyon, about four miles long, 45 caves were counted. Most were smaller than the large one at right but nearly all were suitable for human habitation

All photos by the author

The localities under investigation were two picturesque canyons, both cut into limestone formations and both heading southeastward into the foothills of the Pryor Mountains, the main ranges of which are incorporated in the Custer National Forest immediately to the south. Our principal concern was Sage Canyon, a moderately wide gorge about four miles long. In its opposing cliffs we counted no fewer than 45 caves, varying in size but all more or less suitable for human habitation. Three of them showed painted representations of human, animal, and geometric figures done in red and black on the rear walls. The two largest caves—one of them with a nearly level floor space exceeding 150 square meters—were cleared of culture debris, and some 25 additional smaller shelters were tried out as future possibilities. Thus in all, some 380 square meters of cave earth were excavated to an average depth of over a foot and carefully screened. What we found consisted mainly of chipped and ground stone implements, fragmentary animal bones, and—somewhat disappointingly—a few objects of white man's origin. The principal caves had obviously not been inhabited for any length of time. Also the aborigines, like ourselves, appear to have been short of breath, or else lazy, for the run of artifacts showed clearly that the occupants had preferred living in tents on the spacious canyon floor itself and in the few conveniently low-lying small caves to the really commodious shelters which necessitated a climb of 100 feet or more. The only explanation that suggests itself is that the canyon was frequented merely during the pleasant short summer seasons.

The other gorge, examined on invitation of the Crow Reservation Superintendent, Robert Yellowtail, lies about ten miles to the north and is known as Pryor Canyon. Here within a mile and a half of the entrance one large and several small caves were tried out, with negligible results. Paintings were found on the walls, but the floor deposits yielded no visible streaks of culture debris, though stray artifacts were sometimes present. However, a redeeming site turned up in the shape of a large artificial stone heap, or cairn, lying near the mouth of the canyon, at the base of a prominent cliff variously named as Arrow Rock, Evil Rock, and Medicine Rock. This cairn, about 35 feet across and five feet high, showed superficial traces of artifacts.

To make certain of its nature and contents, a trench was cut fully halfway across the mixed earth and rock composing it. The relics found were in part similar to those from the caves but also included a considerable range of ornamental objects, as well as some 200 potsherds—all confined to the upper half of the deposit. Why this and other smaller rock piles in the vicinity were here and why this one alone contained artifacts are still problems. The Crow Indians whom we asked about it professed total ignorance; but, in the absence of any apparent practical functions, this cairn must have served some ceremonial purpose. The ornaments and the food remains represented by animal bones presumably were offerings.

Summing up our findings, the excavated cave deposits consisted nearly everywhere of a single thin layer of blackish culture debris, lying directly on the surface of the natural cave earth floor, but covered usually by a considerable thickness of recent cattle dung. These black layers alone contained all that we found of archaeological interest. Most conspicuous were a few fireplaces and numerous fragmentary animal bones lying about as proof of what had been prepared in the way of food. Bison, elk, and deer must have been the mainstay; but the wolf, mountain lion, beaver, marmot, and other small rodents were present, while of birds there were only bare traces. Of manufactured articles, chipped stone implements were in the lead, as represented by arrowpoints, spearpoints, drillpoints, knife blades, sidescrapers, and endscrapers, as well as numerous reject cores and flakes. Ground stone implements included natural hammerstones, upper

(Below) One of 25 rock shelters in which test digs were made to estimate possibility for future excavation

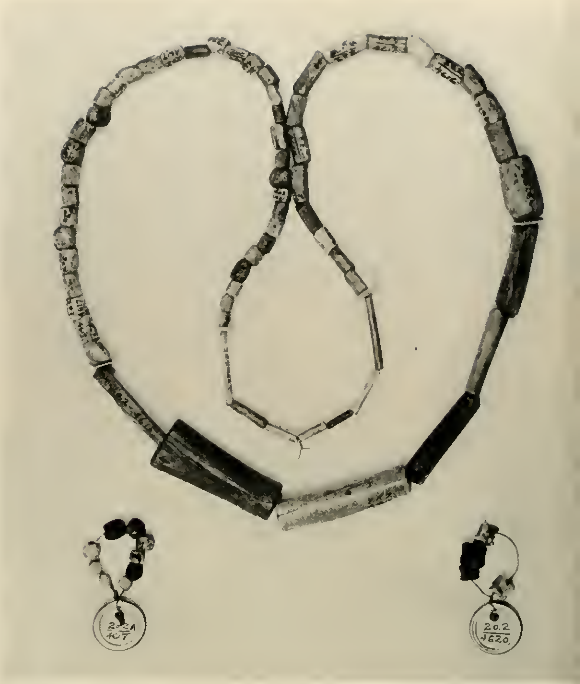
(Above) A rock heap which contained numerous relics and which evidently had religious meaning for the people who made it. The modern Indians knew nothing of its origin

and lower mealing stones, a grooved maul, a grooved arrowshaft polisher, a bar amulet of hematite, and a stone used in preparing skins for tanning. Bone tools were limited to one awl and a chipping tool of antler.

Small and lacking in variety as this inventory was, it nevertheless revealed to us the main features of the life and activity of a simple people who subsisted entirely on what wild nature supplied. Clearly they were not real cave dwellers but—like ourselves—brief summer visitors who possessed skin tents or tepees and who in their permanent winter habitats at lower altitudes probably lived in substantial earth lodges, like their neighbors out on the plains. They hunted such game as the locality afforded and could have fished in the passing stream, though there was no proof that they did so. Apparently the bison, being here perhaps relatively scarce, was stalked by the lone hunter. But elsewhere, not far away and scattered all over western Montana, there are said to be hundreds of so-called "bison drive dumps," as evidence of communal hunting. These "dumps," consisting chiefly of masses of bison bones, occur at the base of cliffs over which the organized pursuers drove the stampeding herds to their destruction, later, if necessary, dispatching the maimed creatures with clubs or bows and arrows. Ten years ago two such sites, littered with arrowpoints of a small, side-notched type, were excavated and reported upon in NATURAL HISTORY (XXXII, 75-82) by Dr. Barnum Brown of the American Museum. But whatever method our cave visitors used they did not live on meat alone. The presence of mealing stones shows that they doubtless also gathered roots, seeds, berries, and other fruits. Of the 1500 native vegetable products said to have been used as food by the American Indians, many are available in Montana. We found the plums and chokecherries in season and they were both plentiful and delicious.

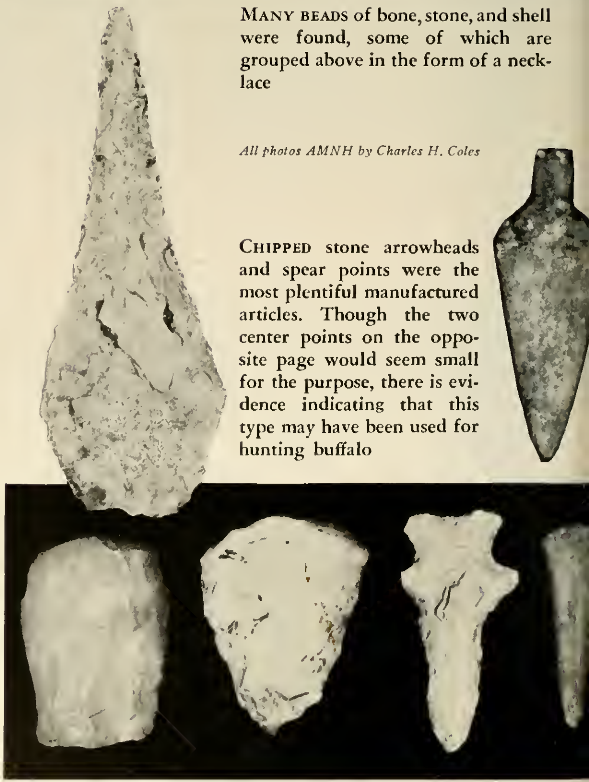
One more touch must be added. The quest for food, while naturally of first importance, did not take up all their time. The cave paintings suggest other interests. In addition, objects for personal adornment, derived mostly from the cairn, comprise a considerable variety of beads and pendants. Most of these are made of bone; others are of shell, including olivella and dentalium, suggesting trade connections with the Pacific Coast; and a few are of stone, for example, steatite and turquoise. Two ornamented dice or game pieces reveal the makers as perhaps all too human. Incidentally, the cairn, like the caves, also yielded a few items of foreign origin. Among these were arrowpoints of iron and copper, pendants of copper, glass beads of various colors, and a bronze medalet dated 1864!

The main conclusion to be derived from our brief survey, as viewed in the light of stratigraphic results recently obtained in Pictograph Cave, less than 40 miles away, near Billings, is that the Sage and Pryor canyons were frequented for only a brief period not long prior to historic times. Who the visitors were can probably never be definitely established. Quite likely they may have been members of the Shoshonean tribes, who are thought to have ranged over the territory in early historic days. At any rate, available information suggests that they were not the Crow Indians now dwelling on the Reservation.

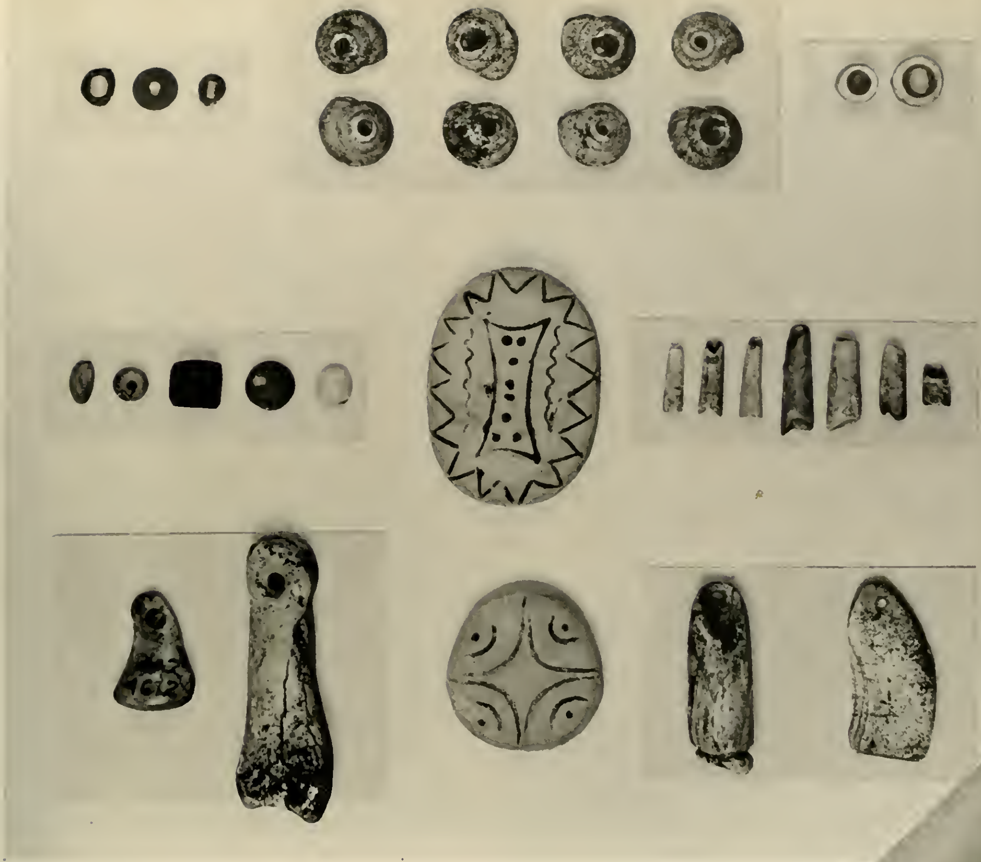


Many beads of bone, stone, and shell were found, some of which are grouped above in the form of a necklace

All photos AMNH by Charles H. Coles

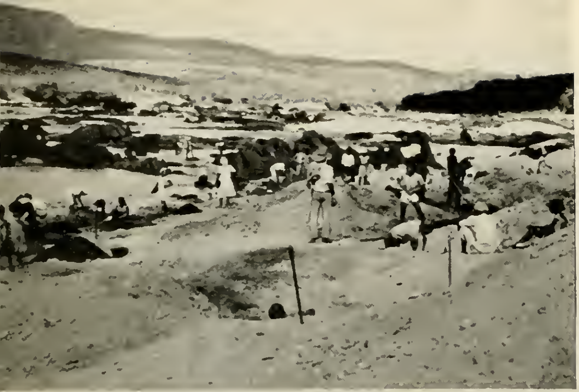


Chipped stone arrowheads and spear points were the most plentiful manufactured articles. Though the two center points on the opposite page would seem small for the purpose, there is evidence indicating that this type may have been used for hunting buffalo

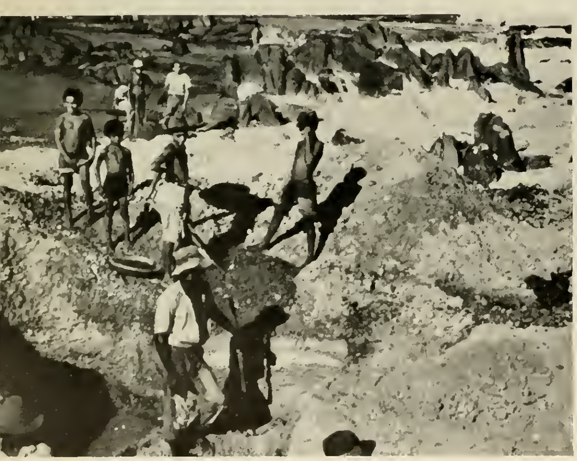


Two dice or gaming pieces are shown above, surrounded by pendants and beads, showing that the people did not devote all their energies to the business of securing food

Once used to grind roots, seeds, and berries by a primitive campfire, the upper and lower mealing stones at right become one more clue to the story of a people unknown even in the traditions of surviving Indians



Above) In the search for diamonds, the *garimpeiros* (diamond eekers) wait for the dry season (April to November) when the river ed is exposed. Then thousands, sometimes entire families, prospect or a favorable location to put in a season of diamond hunting. This hotograph represents the Rio Jequitinhonya in Minas Geraes dur- ng the dry season. During other times of the year, the river covers ll the protruding boulders along the entire valley



Above) Upon finding a favorable location, the *garimpeiros* dig hrough the layers of worthless sand to the bed of diamond-bearing ravel *(cascalho)*, which lies upon the solid granite bedrock. Often he *garimpeiro* piles up as much *cascalho* as possible during the dry onths so he can search the gravel for diamonds during the rainy eason when the river bed is flooded

DIAMO

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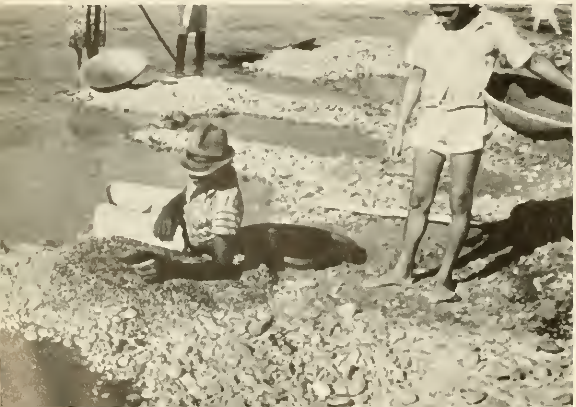
By AL

Photos by the autho

A changing world market and the needs of war-time industries give new meaning to the largest diamond fields in the Western Hemisphere

Brazil has been yielding diamonds since 1721 and now produces about three per cent of the world's supply. Because of the increased need of diamonds in war industries, a source in the Western Hemisphere yielding even this percentage is important. South Africa produces about 90 per cent of the total.

Brazil's diamonds come from numerous rivers draining the high and dry region of the central plateau, and as many as a dozen of the states produce them. Matto Grosso, however, yields the greatest quantity, while Minas Geraes enjoys the greater record for large gems.



(Left) The piles of gravel are first screened so as to eliminate large pebbles. Each stone is examined before being thrown away. The small gravel is then examined very carefully for diamonds. Occasionally small pebbles of cat's-eye, aquamarine, tourmaline, and topaz are also found

(Right) The fine material of the gravel is panned in the large wooden *batea*. Gold is always present, and occasionally small diamonds are obtained in this last washing, associated with a heavy black magnetic sand. Practically all the rivers of the diamond-bearing regions contain gold

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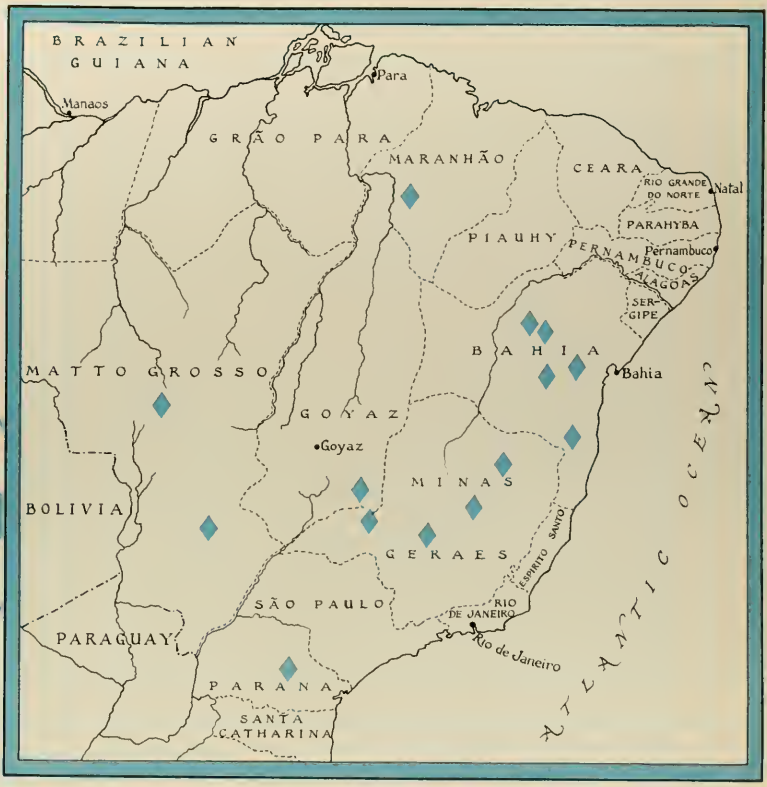
BRAZILIAN GUIANA
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Pernambuco
ALAGOAS
SERGIPE
BAHIA
Bahia
MATTO GROSSO
GOYAZ
Goyaz
BOLIVIA
MINAS
GERAES
ESPIRITO SANTO
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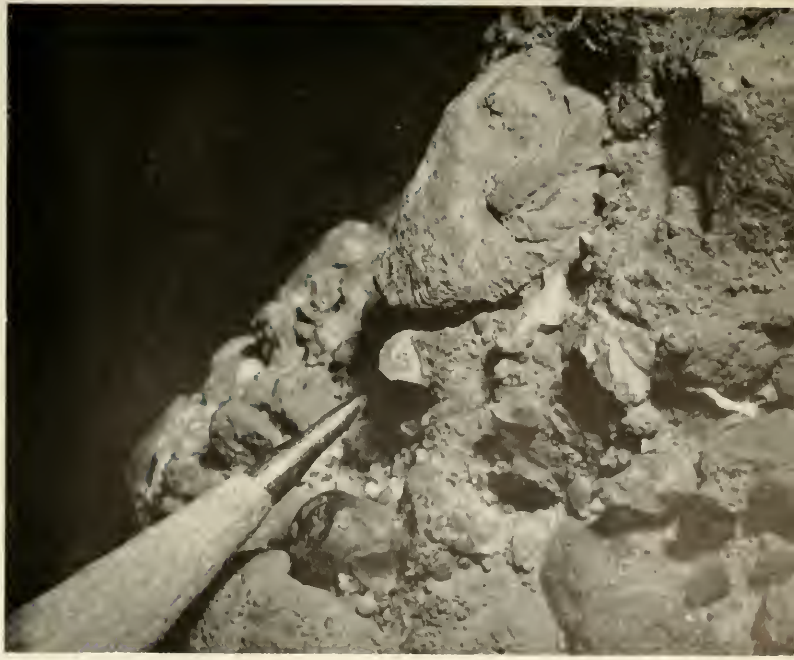
PARAGUAY
PARANA
SANTA CATHARINA
ATLANTIC OCEAN

AMNH photo by Charles H. Coles



A SMALL DIAMOND can be seen embedded in this mass of gravel, which is made up of pebbles and grains of basalt, actinolite, quartz, hematite, rutile, and sand. The diamond is rounded and lacks crystal faces. This reveals that it has traveled a great distance from its source

Hundreds of diamonds. Utility competes with beauty in the modern diamond market, and these crystals are destined for use in polishing, cutting, and drilling steel and rock, and as dies for the drawing of wire.

A—The rarest and most desirable type of industrial diamond is ballas. This South African specimen is of tremendous size, weighing 330 carats. Ballas are round masses of small radiating diamond crystals, concentrically arranged. Because of their structure, they have no cleavage and are exceedingly tough.

B—Smaller ballas like these are more adaptable to different uses than the larger ones. Brazilian ballas are far commoner, also rounder, more compact, and tougher than those from South Africa.

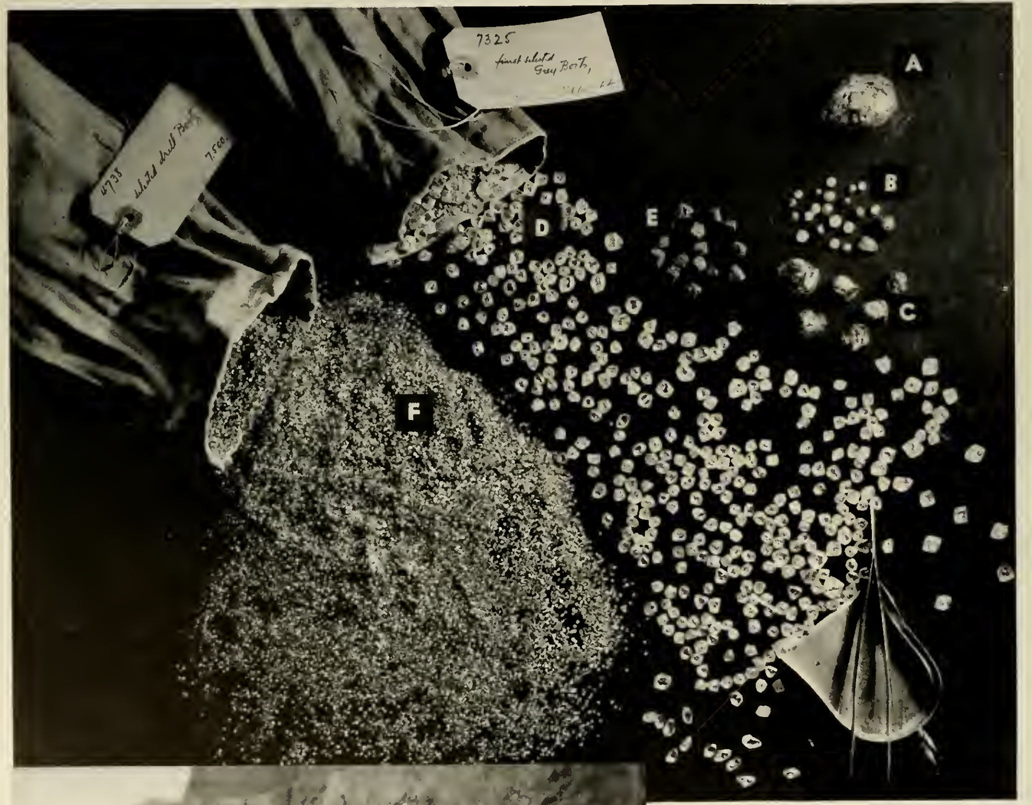
C—Ballas from the Premier Mine, South Africa.

D—Bortz are diamonds of selected quality which are rejected as gems because of undesirable yellow or brown tints or because of black carbon inclusions or flaws. They are generally single octahedral or dodecahedral crystals which cleave easily.

E—Black diamonds, or *carbonados*. These are found only in Bahia, Brazil. They are black or gray; inferior qualities are porous and often resemble pieces of coke or slag. They are tougher than bortz and more adaptable to special uses, because they have no cleavage.

F—Small bortz. These are suitable for core drills used in oil drilling and mine sampling.

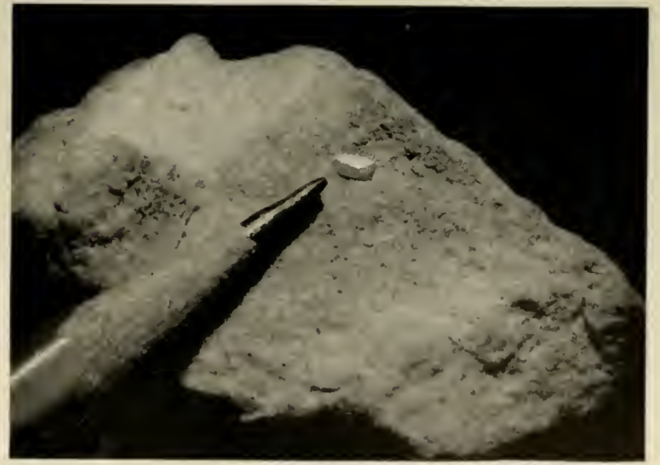
McGraw-Hill photo from Anton Smit and Company, Inc.



(Left) A strong stream of water is used to wash the soft, decomposed material at the Serrinha Mine near Diamantina. The method is similar to the hydraulic system for washing gold in Alaska. This mine is unique in Brazil, for almost all Brazilian diamonds are found in rivers

AFTER POWERFUL hydraulic action loosens the diamond-bearing material, long wooden flumes *(at right)* carrying the *masse* to the mill, where a series of revolving screens eliminate coarse pebbles. Then the remaining material is run through a rotating drum containing steel balls, known as a "ball mill." This crushes the harder lumps and discharges worthless material. The heavy materials drop to the bottom. At the end of each day, the residue is sorted by screening or running through a vibrating table to separate further the different constituents from the diamonds. These diamonds are sharply crystallized and of fine gem quality, showing no evidence of river wear

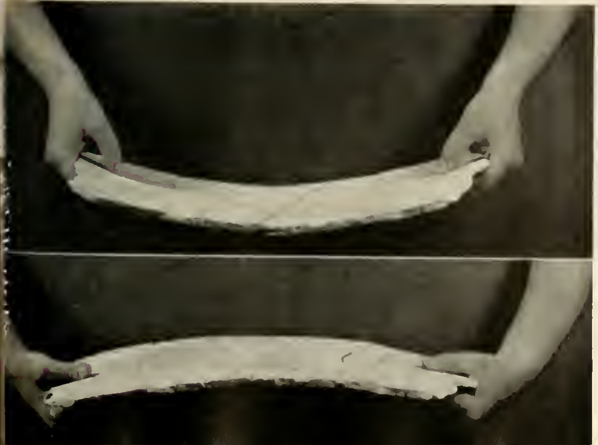
A SMALL WATER-WORN diamond in quartzitic sandstone: a type of occurrence which puzzles the geologist. This ancient formation underlies a large area in Minas Geraes. Diamonds are found in it near Grão Mogol, about 150 miles northeast of the Serrinha deposit described above, which lies within the quartzite formation



AMNH photo by Charles H. Coles

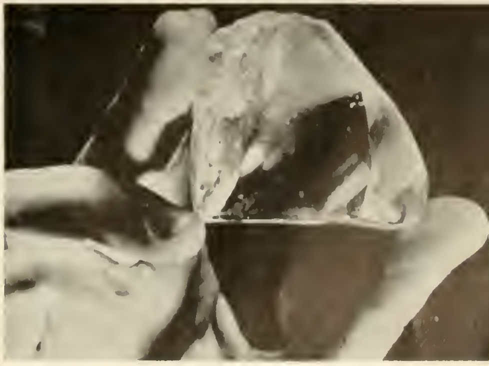
(Below) FLEXIBLE ROCK. Not far from Brazil's deposits of the hardest substance known to man are found specimens of the "softest" rock in the world. This is among the oddest geological curiosities on earth. Slabs of the sandstone several inches thick can be bent back and forth with ease. The rock gives forth a sound when it is bent. Deposits are known in other localities, but the finest is the Brazilian

AMNH photos by Charles H. Coles

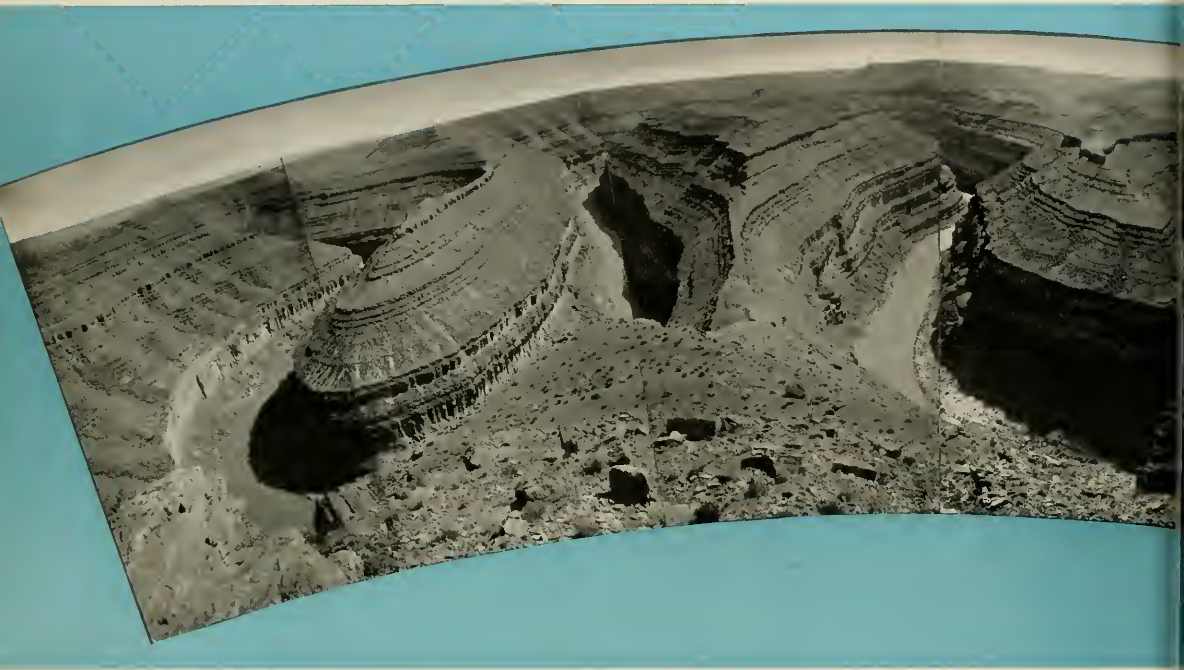


THE PRESIDENT GETULIO VARGAS DIAMOND. Tipping the jeweler's scales at 726.6 carats, it edged out the Jonker Diamond by a mere fraction of a carat to become the third largest diamond in the world. Two *garimpeiros* were greatly enriched when they discovered it in 1938

Photo from Oswaldo Dantes



THE GOOSENECKS



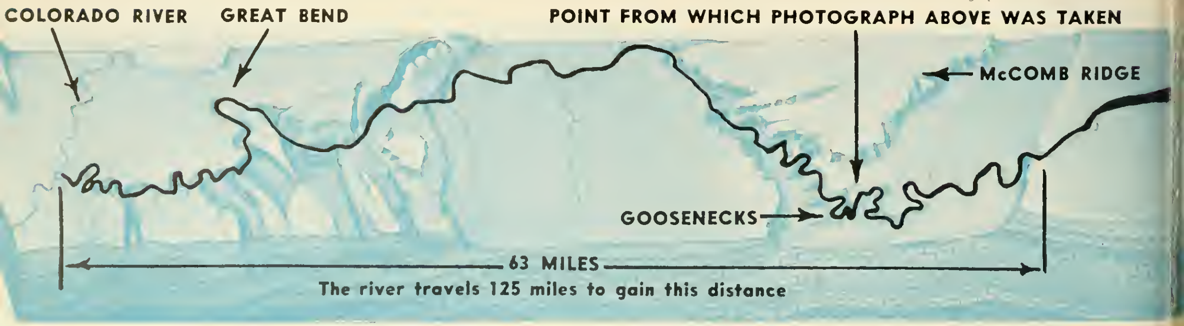
By H. E. Vokes

Assistant Curator of Invertebrate Paleontology,
The American Museum of Natural History

Rivers can do strange things—the Mississippi was even seen to flow backward on its course—, but the San Juan in southeastern Utah, once a commonplace meandering stream, "dug-in" to form one of the most spectacular serpentine canyons in the world

December 16, 1811: it was night and the little hamlet of New Madrid, in southern Missouri, was blacked out in peaceful rest. Shortly after two in the morning, however, there arose a rumbling roar—a noise like that of thunder, but with a deeper and more sustained, menacing note. And then the ground began to rock! Shouting their terror, the astonished backwoodsmen rushed from their cabins. They saw the Mississippi River flowing backward, uphill, in relation to its normal direction of flow! Never had anyone seen anything like that before.

In the succeeding weeks, they were to become all too familiar with the jarring and shaking of their earth. For more than a year it continued to be almost



Drawing by Victor McIntosh

COLORADO RIVER
GREAT BEND
POINT FROM WHICH PHOTOGRAPH ABOVE WAS TAKEN
McCOMB RIDGE
GOOSENECKS
63 MILES
The river travels 125 miles to gain this distance

OF THE SAN JUAN

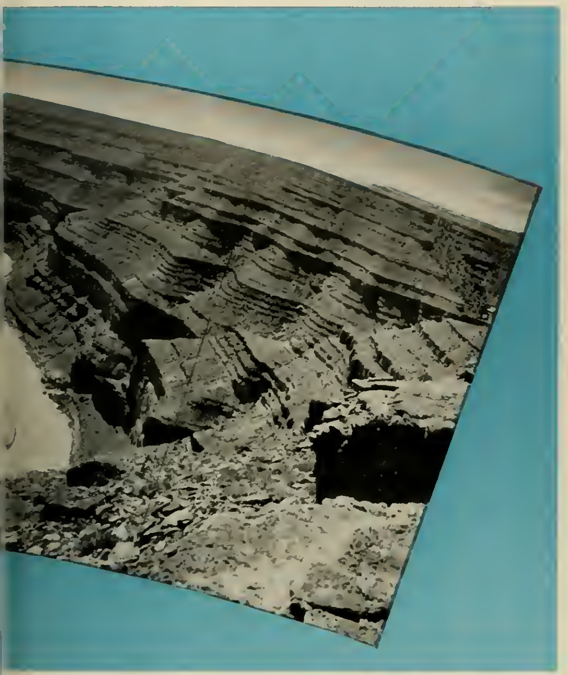


Photo by Weyer

constantly convulsed; within the first three months there were more than 1800 distinct shocks. The heaviest quake of all occurred on February 7, 1812, when many trees were actually snapped off by the jarring motions. At New Madrid the graveyard slid forward until it rested in the bed of the Mississippi River, and the ground on which the town stood, as well as the river bank for fifteen miles above it, is said to have sunk almost eight feet below the former level. These people were living in the terror of one of the greatest earthquakes of historic time. They saw the earth open in great fissures, through one of which a near-by small lake was suddenly emptied of its waters. But they did not again see the Mississippi River flow backwards.

What had caused it to flow in that direction on December 16th? The evidence is inconclusive. There were no trained observers in the region during those pioneer days, and there were no modern scientific instruments to record the precise nature of the shocks. But it does seem most probable that there had been a local and temporary uplift of some section of the river bed during the period of that first great shock. Normal conditions were apparently soon re-established, and the river resumed its usual direction of flow. But what if they had not been thus re-established? What if the land had even continued to rise?

If the violent and abrupt uplift had continued as it began on that long-distant night, the Mississippi River of today would probably be emptying through the Chicago River into Lake Michigan, and a shorter, much smaller stream would now be passing through the channels near New Orleans.

But if, on the other hand, the rate of the uplift had been slow, as imperceptibly slow, perhaps, as the uplift which is even now going on along our northern Atlantic coasts, it is probable that the current of the Mississippi River would have been able to cut its channel as rapidly as the land was lifted. The river would then flow between banks of increasing height; and if the amount of the uplift were great enough, a time would come when the Mississippi would flow through a deep, steep-walled canyon.

This didn't happen to the Mississippi River. But it did happen to the San Juan River of southern Utah. Once this river was a stream much like the Mississippi. Some two million years ago it, too, meandered back and forth across a broad flood plain, tracing a tortuous, snake-like course as it lazed along on its slow voyage to the Colorado River.

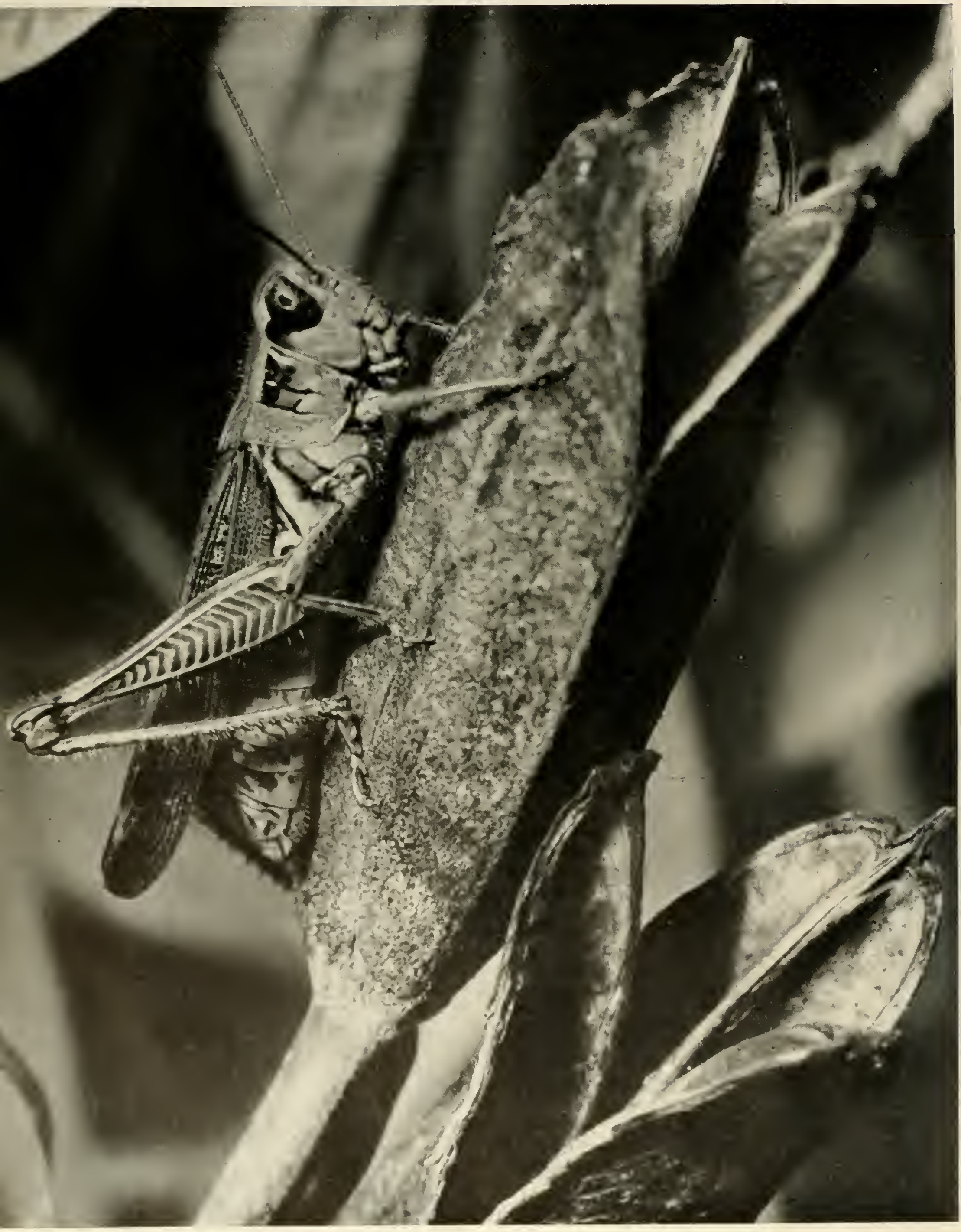
The plain across which it flowed was the same plain under which were buried the craters and the fragmented rocks of the volcanic eruptions described in last month's NATURAL HISTORY in the story of Shiprock. And the uplift which produced the San Juan canyon was the same uplift which finally resulted in the exposure of those monuments.

This uplift was very slow and occurred only along the lower half of the river. There the river cut its bed deeper into the land as the banks rose about it. Soon the channel was so entrenched that the stream was no longer able to shift its course under the pressure of the floods and freshets. The crooked course which it had developed during its free and untrammeled days was now indelibly impressed upon it. In the region of the Goosenecks it now had to travel 23 miles to gain an actual air-line distance of seven miles. In the Great Bend it now had to travel eight and one-half miles to gain one! And from the place where it entered the canyons, near McComb Ridge, to the place where it entered the Colorado River, it had to travel 135 miles to gain 63. Its journey was just twice as long as if it had set a direct course and never wandered from the straight and narrow.

And still the uplift continued; the soft sediments which surfaced the plain were worn through, and the river came upon the harder rocks underlying the plain. These rocks were folded into broad swells and valleys which crossed the river course at right angles. Ordinarily, such folds of harder rock are able to alter the course of a river, but not so with the San Juan. It was fixed upon its course. It could only continue in the channel which it had already cut so deeply, a channel which led it across the valleys and over the ridges. And so today, the San Juan River is noteworthy not only as one of the most crooked streams in the world and one that has entrenched its spectacularly deep snake-like meanders; it also is a stream which has subsequently disobeyed the usual rules imposed on rivers by the structure of the underlying rocks in their paths. It is an impressive wonder of our scenic Southwest.

SEEING NATUR

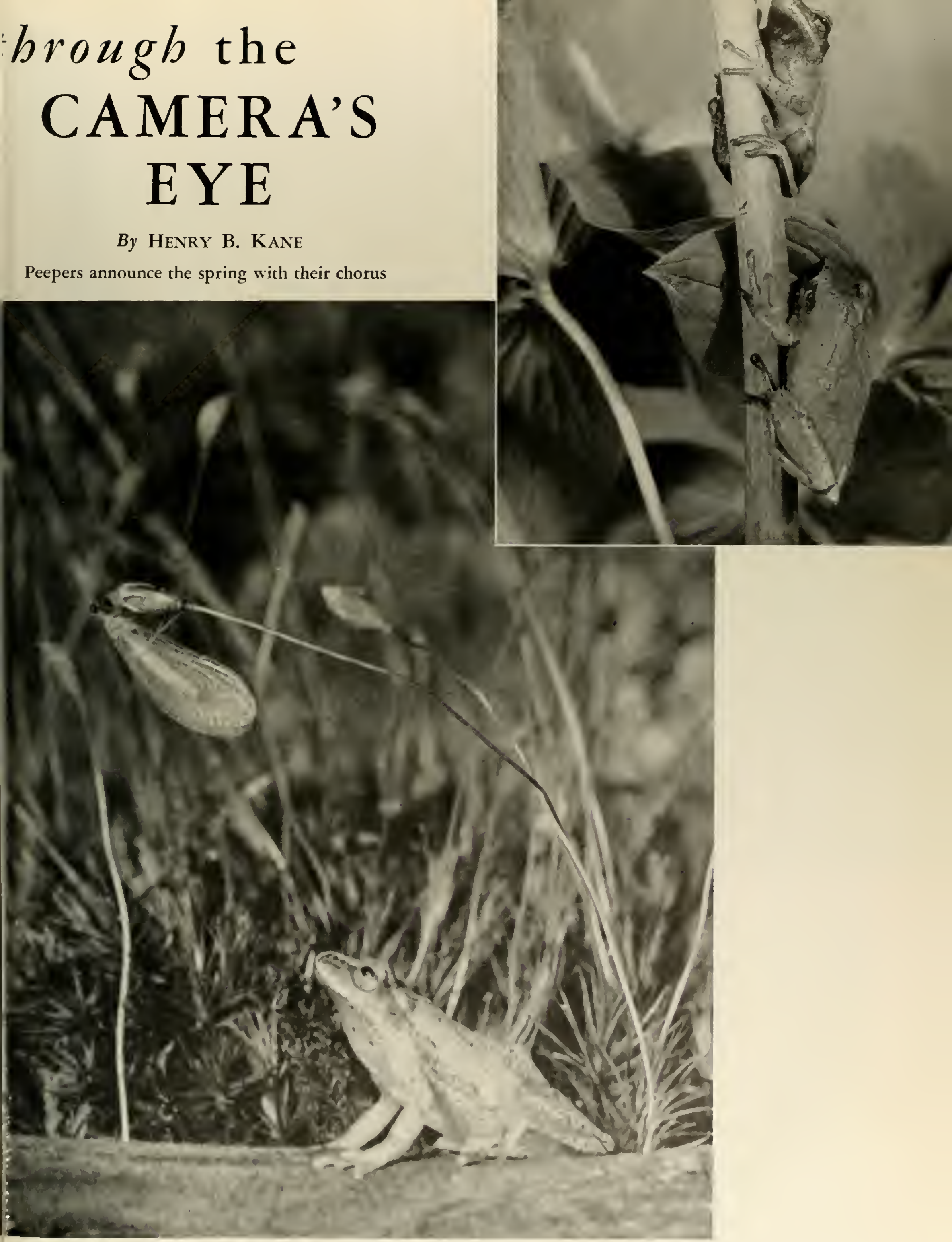
G is for Grasshopper

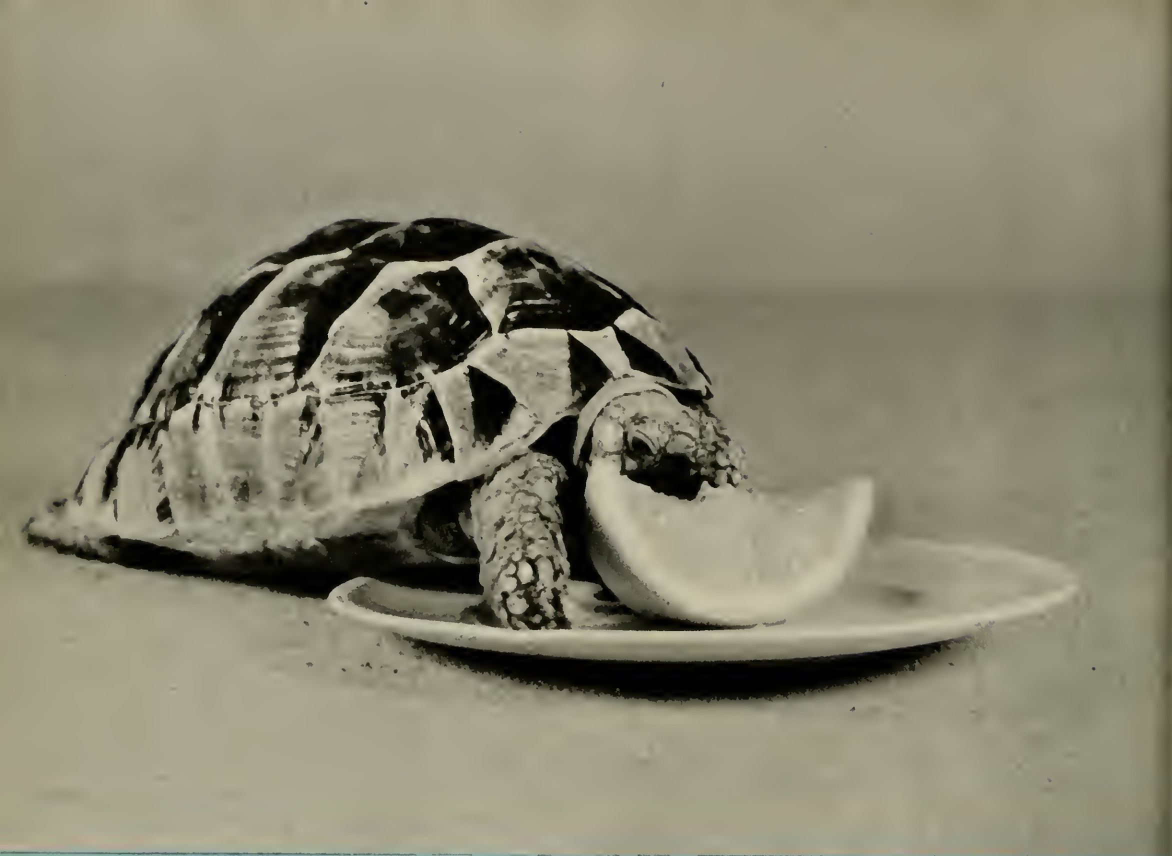


through the CAMERA'S EYE

By HENRY B. KANE

Peepers announce the spring with their chorus





ORANGE for breakfast. Cleo has a Rastus-like capacity for watermelon, her favorite repast

OUR CLEOPATRA

An Egyptian Tortoise

By LILIAN RIVERS WEIDLICH

PHOTOGRAPHS BY EDWIN C. WEIDLICH

A "LITTLE souvenir from Egypt" was given to my husband and me three years ago. The tortoise from Alexandria immediately won our hearts, and we determined to do our best to make her enjoy life as a domestic pet in the United States.

Her name, Cleopatra, was inspired when Mr. Charles M. Bogert, Herpetologist at the American Museum of Natural History, determined that our unusual pet belonged to the only species of tortoise found in Egypt, *Testudo leithii*. She is an adult female with an uncertain past.

We have written to natural history museums and zoos throughout the country, and to date we have found no other specimen in the United States. Apparently Cleopatra thrives on our western civilization, for her weight has increased from twelve ounces in 1939 to eighteen ounces today, which is considerably heavier than the largest specimen mentioned in Major Stanley Smyth Flower's "Notes on the Recent Reptiles and Amphibians of Egypt . . .",* which contains the most complete and recent information on the animal.

Cleopatra's back shell, or carapace, measures eight and one-quarter inches long and seven and one-half inches wide. The shell is pale yellow, with lemon and yellow-green lights and shades, and a definite series of brown or reddish-black markings. The undershell is yellow, with a red-brown to black marking. Her eyes are very noticeable, like bright black buttons, and her exposed parts are yellow.

Not having any scientific information regarding feeding habits, we had to take up that matter with Cleopatra herself. During her Atlantic crossing, she tried a little of everything offered to her from eggs and toast to salad, omitting meat and showing a definite preference for lettuce and fruit. Since we have had her in the States, we feed her a large variety of fruit and vegetables. Her favorite dish seems to be watermelon, but cucumber and radish leaves run a close second. We keep a small container of water for her, which she seldom drinks, except when her face is sticky (after trying a little marmalade, for example). When immersed in water, she drinks some.

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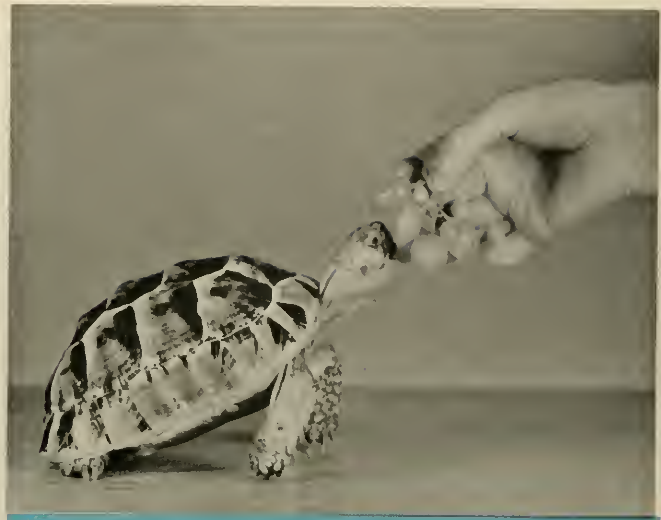
* See *Proceedings of the Zoological Society of London*, 1933, pp. 745-750.

However, as the following record will show, Cleopatra has cultivated habits and received attentions in New Rochelle, New York, not ordinarily enjoyed by her species. She was given a little red house all her own, and it did not take her long to realize that it belonged to her. For several days we continuously picked her up and put her into the house. She was never disturbed there, and before long she began going into the little house to sleep, coming out only for exercise and food.

Another step in her domestication was housebreaking. When food is brought in sight, she releases what is stored in her "reservoir." Upon discovering this, we began to place her dinner plate on top of a newspaper. The system worked perfectly—except that she has apparently become conditioned to the presence of a newspaper, and we have learned through experience never to leave any newspapers lying about the floor.

Cleopatra likes warm weather but finds sitting under a radiator about as much fun as a sun bath. When it is cold, she sleeps in a warm bath towel and does not come out to eat in the morning until the house is quite warm. Sometimes in extremely damp weather, she sleeps for a few days at a time, but she makes up for it by eating more than ever when she does emerge. In summer, she likes to dig in the back yard, but in winter she just plays in her sand pile. She likes to sit in warm water, but shows no interest in swimming.

Cleopatra is no example of the proverbial tortoise's slowness, for she is extremely active. She rushes to my husband or to me when we call her, by means of taps on the floor. As a reward, she expects to be fed or at least to be tickled under the chin. She usually starts her day by coming out of her house to climb over my husband's feet as he is shaving. She climbs over and under furniture and has become quite an acrobat. She likes to climb over and over the hurdle Eddie has made for her or, better still, she likes to receive his undivided attention and do acrobatics on his hands. She



ON TIPTOES for grapes. Cleo thrives on our western diet and proves it by sporting the record weight for her species

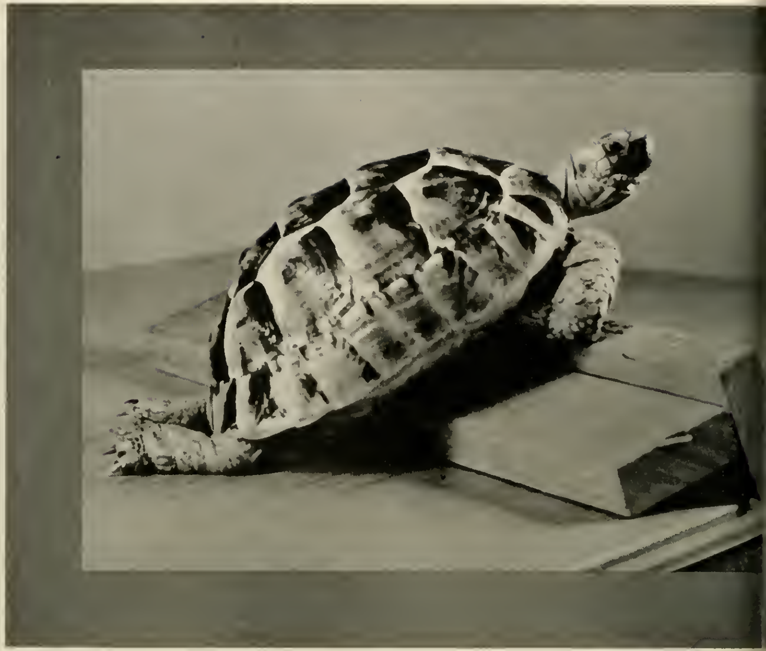
ADMIRING CHILDREN are Cleopatra's most enthusiastic friends

has the patience of Job and will work for hours on a project. For example, when we lived in an apartment in New York City, Cleopatra spent weeks trying to climb up the three-inch step to the bathroom. When she finally succeeded, it became her favorite sport.

Cleopatra dislikes heights. A table or a chair, from which she cannot descend, is a prison for her. She paces continuously back and forth, looking over every section of the precipice until no possible method of escape has been overlooked. But she takes no real risks and has never fallen. If there are no means of escape, she usually gives up and goes to sleep.

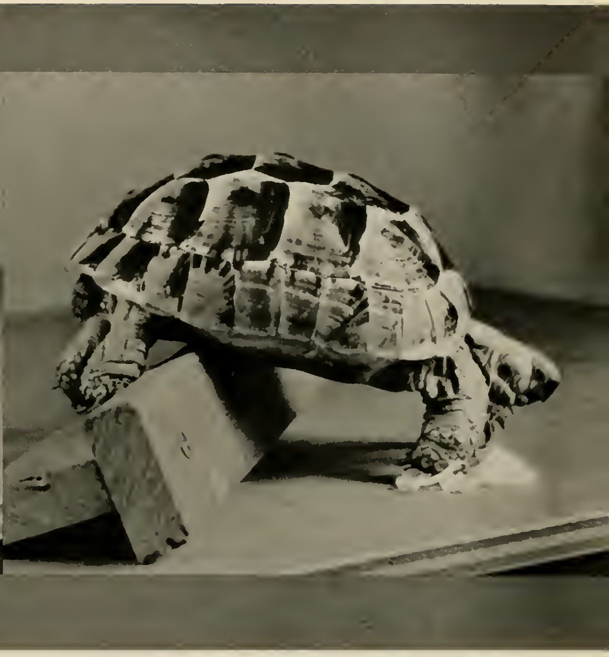
Cleopatra has become so very tame that we fear she would not last long back in Egypt along the Nile. She has practically forgotten how to pull herself into her shell. She sleeps with her head out and seems to be too curious, even among strangers, to keep it in more than a few seconds at a time.

She is an interesting pet, and we are even looking forward to the time when we can get her a mate from Egypt.



WITH the patience of Job, Cleopatra masters the hurdle

FREDDIE is Cleopatra's "protector." Trusting curiosity has won her many friends



THE PROVERBIAL HARE would be surprised at her agility

CLEO co-operates best if a tempting morsel is her reward

STICKING HER NECK OUT is safe in her new home. She has almost forgotten how to duck

STRATEGIC MINERALS

NUMBER V

MICA

Mica, mica everywhere, on our earth and in our earth, but the large crystals whose unique properties are so essential in wartime are scarce and costly to process

By FREDERICK H. POUGH
Associate Curator (in charge), Geology and Mineralogy,
The American Museum of Natural History

THE entire earth's crust—in many places from the dirt mantle down, and elsewhere below a superficial layer of sediments—is composed of igneous rocks, such as granite, diorite, gabbro, and peridotite. A high proportion of granite and diorite, and an appreciable amount of the gabbro and the peridotite, is mica. Yet mica, the dominant constituent of many metamorphic rocks and a prominent constituent of the igneous rocks, is on our list of strategic materials—materials of which our domestic supply is insufficient for our needs.

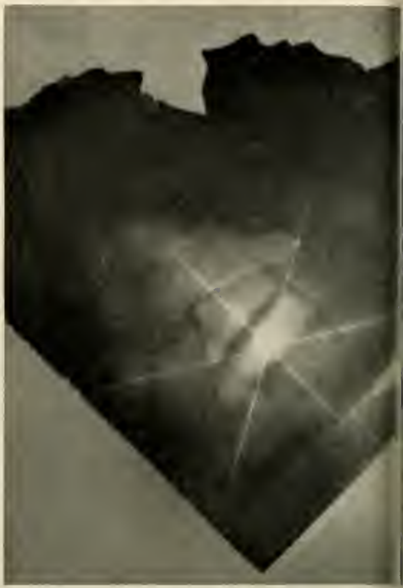
One might suppose that mica was one of the last things to think about in our war industries. Probably few people appreciate the part that this common mineral, with its unusual properties, plays in our daily lives. As one small use: 250 million small mica plates went into our automobiles annually. Did you have toast this morning? Mica served an important purpose in your electric toaster. Were your clothes pressed? Without mica the electric iron would not be so small and handy. Did a plane fly over? Without mica the plane would not be so safe. Did you ride in an elevator? The elevator ride, while possible, would have meant much more trouble for someone.

So it goes with mica, and our lives have been built on the belief that mica would always be available. Substitutes would work, different motor and generator designs could be developed,—but they haven't been, and now we should find it difficult to get along without mica. Right now we must view the situation with the greatest concern, for almost all of the world's fine quality mica comes from India.

Mica is a general term; it includes a number of minerals, some of which are useful and some of which are not. Though mica is used in a number of ways and in different conditions, all of the uses are dependent upon its unique physical properties. The micas are a mineral family; they are hydrous silicates of potash and alumina; magnesia and alumina; magnesia, iron and alumina; or lithia and alumina. There are a host of others, and one mica may grade into another, but these are the commonest and they are called muscovite, phlogopite, biotite, and lepidolite. In color they may vary from white through brown to black and lavender. Some of the properties, like the color, differ according to the composition, but all types of mica possess several things in common, the most obvious of which is a pronounced basal cleavage.

Cleavage is the tendency of a substance to break in definite planes, leaving a smooth fracture surface. Some minerals cleave with ease, some with difficulty; some have cleavage in several directions, some have it in but one. The micas have a single pronounced cleavage which is parallel to the base of the original crystal.

This alone, however, does not explain the unique desirability of mica. Topaz too, has a fine basal cleavage. But if you could get such thin plates of topaz, they would not have the toughness and the elasticity of the mica flakes. Some of the best quality of mica, known as "cigarette mica," can be rolled into a tube surrounding a rod one-eighth inch in diameter, without breaking, crumbling, or having its surface impaired in any way. Many other things can be thus bent, it is true, even this paper. But can you think of another that can then be heated to above 1000 degrees and remain a good insulator while a 12,000 volt electric current passes through the rod? That is what mica must do, and does. At the same time it is tough, it cannot break under normal conditions, it resists water and acids, and is transparent, even in fairly thick sheets. All of these remarkable properties make it valuable in industry. The ease with which it can be split and its resistance to electricity indicate its field of usefulness; its strength, flexibility, resistance to heat, and softness determine the applications.



Mineral collectors take pleasure in finding phlogopite sheets showing a star—like the star in a sapphire. These stars are caused by innumerable microscopic parallel inclusions

Though mica is an important constituent of many rocks it is not the kind of mica that is strategic, and little "rock-making" mica is used commercially. The mica which we need, the mica whose supply is now so critical, comes in larger crystals than those we see sparkling in the granite and the schists. As a last stage in the crystallization of a mass of granite there are often many small sheet-like intrusions which crystallize with much larger crystals than those of the granite rocks of the main mass. These are known as pegmatites, and in them we find rare

(Left) Only clear, transparent sheets of mica provide the punched-out forms vital in electrical equipment. Mica containing iron oxide *(background)* is valueless for such use

minerals which were not present in any of the rock from the parent magma, along with the common quartz, feldspar, and mica. Many of our gems owe their birth to these pegmatite dikes; tourmalines, aquamarines, and topaz are found in such deposits. And the mining of mica is much like the pursuit of these rarer gems, except that when mica is mined it is desired for its larger crystals, not because it cannot be found elsewhere. Whereas crystals in the rock may be millimeters across, the crystals in the pegmatites are measured in centimeters or even meters.

The micas which are widely used and which are considered critical are two: muscovite and phlogopite. Muscovite is a potash aluminum silicate, and its name is derived from the original source, Russia, whence it was brought to England for use in stove fronts. It no longer comes from Russia, but its use in stove fronts and in peepholes in blast furnaces still accounts for an important percentage of the finest and most transparent cleavages. Its unfusibility and its stability under heat makes it the only material which can be so used. Phlogopite, the magnesium equivalent of muscovite, is even more resistant to heat but less transparent; its name is derived from a Greek word meaning flame-colored. Muscovite is usually light in color and ranges to a red-brown, the latter shade often being known as ruby-mica. Phlogopite is usually darker brown and is commonly spoken of as amber mica, to distinguish it from the muscovite.

Each has its special uses, though if the emergency required, Canadian phlogopite could undoubtedly be substituted for many of the things in which Indian muscovite is now used exclusively. Both minerals crystallize in the monoclinic system, but their crystals look hexagonal in outline. Phlogopite is relatively soft, about the same as copper, and because of this, it is easily split into its cleavages. Because of the molecular cohesion in the basal plane, amazingly thin layers can be split off. A common thickness widely used is about one-thousandth of an inch. Sheets no thicker than this can be obtained in almost any size the crystal will permit, perhaps 80 square inches in area or even more. Normally, of course, they are much smaller. The splittings are very tough and flexible, they may be rolled and bent with no sign of rupture, and through it all they retain their resistance to the passage of an electric current. Being so soft they are easily cut; and the shapes desired are commonly punched out by steel dies. One or more shapes may be cut from each piece of clear mica, as we see in our illustration.

The American shortage of mica is as much an economic problem as geologic, for mica requires considerable preparation for use. This handwork is expensive and requires a certain amount of skill. The skill and the cheap labor supply has been developed in India for many years, with the result that today that country dominates the world market. The mica is mined in more or less regular crystals, which are embedded in quartz or feldspar. These are "cobbed" to clean off the attached rock, and then they are "rifted" into sheets thin enough to be cut with a blade. The sheets are trimmed to remove the tattered edges and impure portions, and then are graded according to size and quality.

The best quality is clear and flawless. Iron oxide inclusions, like those in the sheet which forms the background of our picture, make the mica valueless for electrical purposes. The sheets are then split to different thicknesses depending upon the use intended. "Blocks" are one-hundredth of an inch or more thick, "films" are nine-thousandths down to one-thousandth of an inch thick, and "splittings" are thinner than one-thousandth of an inch. The splitting is done by hand, one person doing from three to four pounds a day for the equivalent in India of three cents a pound. Machines to do this work have been tried, but without much success, and the cheap Madagascan and Indian labor have kept the need from being urgent.

Most of the electrical mica is in the form of splittings, and these thin films are built up into a mica board composed of alternate layers of overlapping mica splittings and a binder of shellac. These boards can be made to any desired size, and for many uses they are as satisfactory as single mica blocks. Molded mica products are often made from such mica boards. Usually in these the binder runs to more than the one or two per cent found in the flat sheets.

Your toaster wires are wound around a mica sheet, or probably around several mica sheets which have been fastened together with small rivets. Your electric iron is similarly equipped, though with a single sheet. But these are dispensable uses. In electric generators, electric motors, and radio tubes, mica is indispensable, to separate hot parts through which electricity is conducted and thus avoid short-circuiting and power loss. In airplane spark plugs, mica (both mus-

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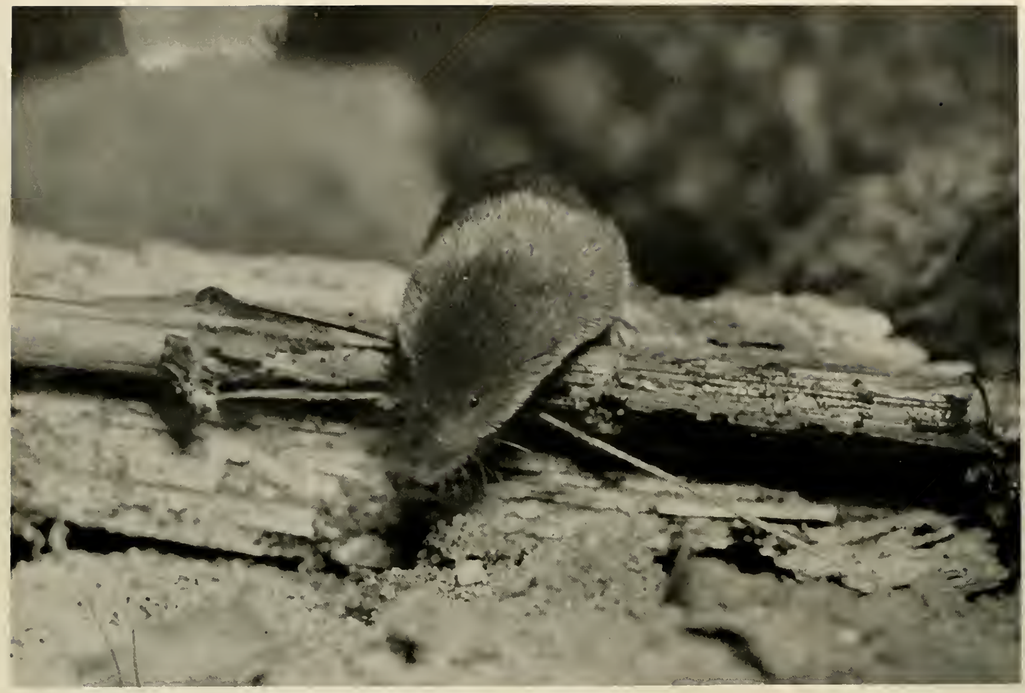


In search of plunder: "Nothing there." This mite of an animal sees poorly with its tiny eyes, but its other senses are excellent

(Photos twice natural size)

THE TAMING OF A Shrew

By GEORGE G. GOODWIN

Associate Curator, Department of Mammals,
The American Museum of Natural History

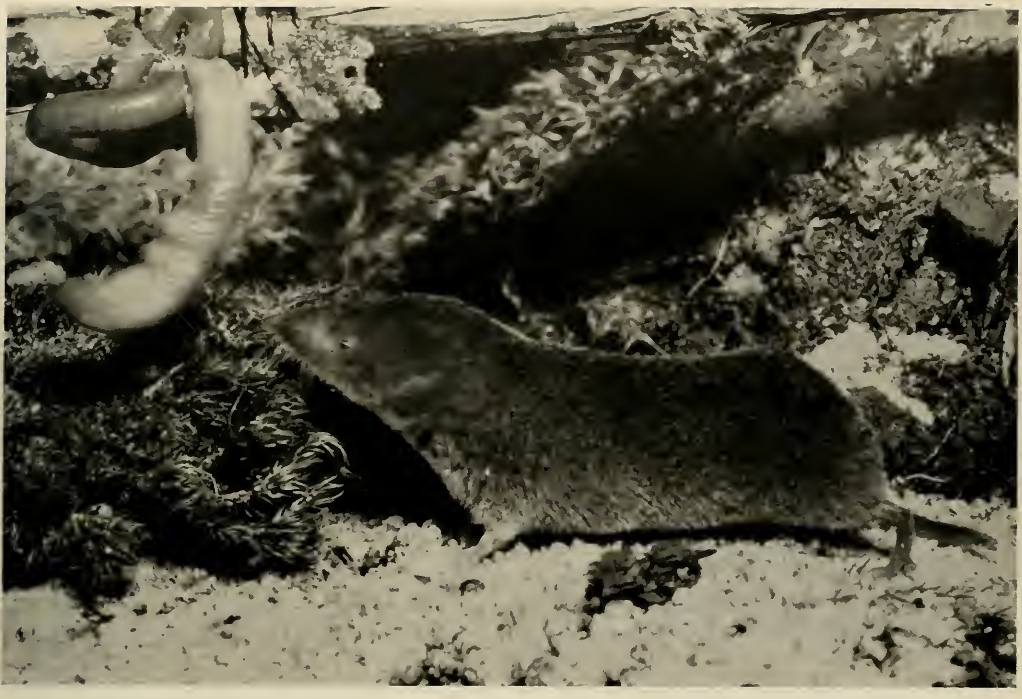
All photos by the author

Though only an inch and a half long, the first pygmy short-tailed shrew found in New England in over a century proves to be a lively and interesting pet

SOME years ago I read an article in which a scientist at the Smithsonian Institution turned over a rotten log in Maryland and found a pygmy long-tailed shrew—the third specimen of that rare shrew on record. Since then I have never been able to resist the temptation to look under fallen, moss-covered logs in the woods. And it is surprising what a number of interesting little creatures one finds there.

But perhaps my greatest surprise came last summer when, turning over an old log on a salt marsh at Westbrook, Connecticut, I saw a tiny furry creature, whose body was no more than one and a half inches long. It was darting along a shallow runway, making for the nearest cover.

The short tail was what caught my eye, for that is what distinguishes the rare pygmy short-tailed shrew from the commoner long-tailed species. It therefore became very important to catch this little animal and determine whether so rare a prize had been found,—an animal of which only one other specimen had ever been recorded in the whole of New England, and that one more than 100 years ago. The first specimen had been taken by Linsley in 1840, at Darien, Connecticut.



(Above) AGILE AND FEARLESS, he could kill many times his weight in garden worms—veritable giant pythons to him

(Below) WHEN he became accustomed to his new home, the least sound brought him stalking from his den

"SOMETHING UP THERE?" his nose asks. He proved that even an animal weighing only 1/7 of an ounce can have personality

Catching these little denizens of the woods by hand requires some experience, not only to avoid hurting the little creatures but because they move with surprising speed in their own territory. To grab at them usually leaves one with only a handful of soil or leaves. When in Turkestan I learned a trick in catching the small desert mice that come out of their holes a foot or two. It is based on the principle of guessing where the animal will go when frightened. You then grab where you expect the animal to be—at the mouth of its hole if one is visible, or at the nearest natural shelter. Snap judgment is necessary, but practice brings results.

The little shrew was making for the nearest shelter so my hand automatically reached for the same spot. Fortunately we met, and I held a miniature in animal life if ever there was one, a tiny creature with a soft silky coat, minute eyes, long mobile nose, the tiniest of feet, and a short tail. There could no longer be any doubt; it was the pygmy short-tailed shrew, named by the celebrated American scientist, Thomas Say, *Cryptotis parva.* It weighed three and three-quarter grams, or less than one-seventh of an ounce, though it was fully adult.

Shrews rarely live long in captivity; few indeed survive more than a few hours when taken from their natural surroundings. I had little hope that mine would be any exception, but he sustained the journey back to the city in a box with a layer of moss and an ample supply of insect life for food. A real domicile was provided for him, with all the comforts of his woodland home—mossy bank, sandy area, the coveted rotten log, and a swimming pool. This was explored from end to end; then he secreted himself underground. For two weeks we had nothing more than fleeting glimpses of him, as he scurried for cover whenever anyone came around. Gradually he associated my presence with food, which he would grab ferociously and drag away to devour under cover. In his tiny mouth he would unhesitatingly seize a big garden worm, to him like a giant python, and skillfully avoid its writhing coils. Sometimes the worm would succeed in getting its tail anchored in the soil, and there would be a violent tug-of-war. The worm, being stronger, usually won the first round. Nothing daunted, this resourceful little creature immediately dived underground and presently the monster went "into reverse" with the shrew on its tail, and the battle was soon over.

As time went on he became more bold and at the sound of my footsteps was out nervously pacing back and forth waiting for his supper. Never for a moment did he remain still. If nothing else, his mobile snout was twitching around in all directions. A camera with shutter set at 1/200th of a second failed to stop his actions. Like all shrews, he could not see very well, and I am convinced he could not recognize his food held two inches away. But once it touched the ground, he was there like a flash. He had a good sense of smell, while his hearing and sense of touch were really acute.

He learned to eat out of my hand and even crawled over my palm to pull at his food, with his tiny feet pressed firmly on my fingers. When once he got the food free, he would scamper off to store it away, and

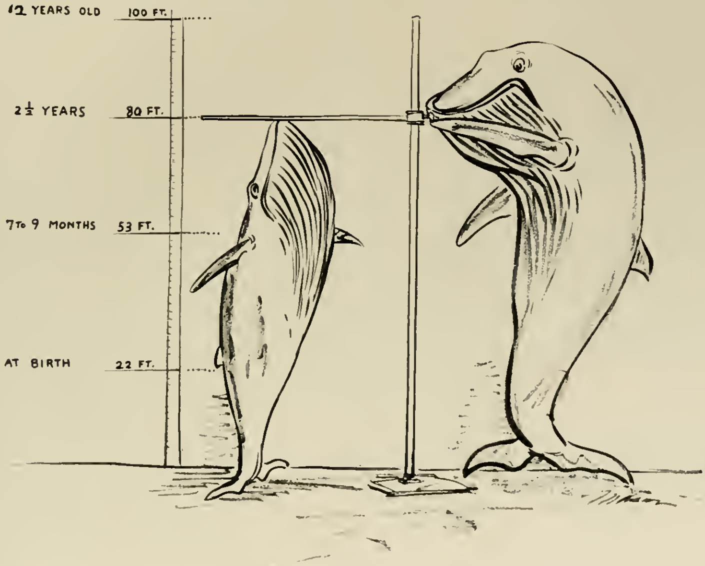
RETREAT. Note characteristic short tail *(below.)*

was then back for more. I fed him once a day but gave him more than he could eat at one meal. Raw beef, liver, chicken, meal, and garden worms made up his daily diet, and for a special treat he got amphipods that I found under driftwood along the beaches. Of these he was very fond.

He was a ferocious little creature for all his size. He worked laboriously over a whole can of worms, dragging them out one at a time and villainously murdering each one, until the whole can was empty. Then he made another trip to be sure he had missed none. I found the whole collection underground in one spot, more than he could possibly eat in several days.

He lived four months in my care and showed considerable courage and daring. We had not hoped we could keep him as long as this; but the loss of this diminutive creature was something of a tragedy all the same. He contributed more than his share of pleasure and in addition contributed to our understanding of his kind, so that his life in its end has been preserved for the enlightenment of science.

THE LARGEST ANIMAL


12 YEARS OLD
100 FT.
2½ YEARS
80 FT.
7 TO 9 MONTHS
53 FT.
AT BIRTH
22 FT.

By JOHN ERIC HILL

Drawn by
G. FREDERICK MASON

THE blue whale, sometimes called the sulphur-bottom, is not only the largest mammal but it reaches the largest size of any known animal, living or extinct. Until recently it was thought that an animal of such great size would need a long time to grow up. The largest land animal, the elephant, does not reach adult size until about 25 years old, and the elephant is a pygmy compared with the great whale.

A few years ago, scientists were sent out to the whaling stations and on ships to learn all they could about whales. Hundreds of whales were measured and examined, and the facts discovered were surprising.

The largest unborn whales reach 22 feet in length, and the youngest baby whales accompanying their mothers were about that length. Thus the blue whale was shown to be larger at birth than any land mammal. The examination of some 50 unborn whales showed that a whale embryo only a foot and a half in length was shaped almost like the adult and that growth in the latter part of its life before birth is rapid. The total period before birth is only about eleven months.

After the calf is born, it more than doubles its size in approximately the first seven months. As long as it is dependent on its mother for milk, the whalebone-sieve in its mouth remains small, but once the youngster begins to feed itself this sieve is needed to catch its food. Whales about 53 feet long are the smallest that have usable whalebone, and calves still suckling are only a little smaller than that.

The young whale, now beyond infancy and beginning childhood, does not grow so rapidly. But by the time it reaches adolescence and the time of potential parenthood, it is about 80 feet long. This is at about two and a half years of age. Males are a little smaller than females.

How old do the great whales get to be? No one can say exactly, but the ovaries of the cow whale retain a record of each breeding season through which she has passed, for a scar is left each time an egg-cell breaks out of the ovary. By counting these scars it is possible to judge approximately the age of a whale. The oldest known blue whale was about twelve years old, as determined this way, and the maturity of her skeleton showed she could not grow much more. The longest whale for which accurate measurements are known was about 100 feet.

Thus, after years of guessing, application of scientific methods has resulted in a relatively clear picture of the growth and development of the greatest mammal.

HIDDEN VALLEY

By JOHN H. DEPRY

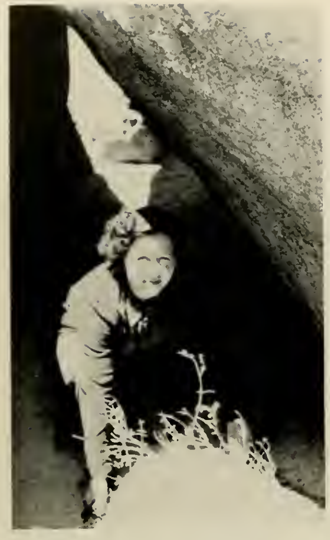
A HIDDEN valley you have to go through a tunnel in the rocks to enter is one of the curious natural wonders in Southern California. The rocks that surround the valley are practically impossible to climb.

This strange "valley without a mouth" lies 25 miles north of the well-known Salton Sea, a lake without an outlet. By automobile it is about 25 miles from Twentynine Palms, the nearest town.

Having crawled through the rock tunnel, the visitor looks out upon a weird landscape in which juniper, sagebrush, and several species of cactus constitute the principal vegetation. There are many lizards, snakes, birds, and small mammals, possibly even wildcats in the valley and surrounding rocks.

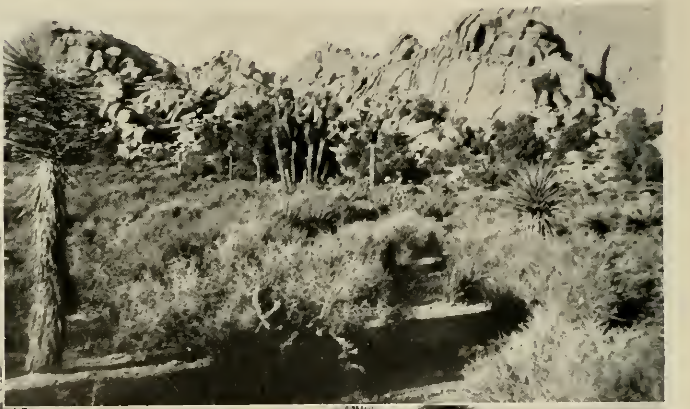
Indians are said never to enter the valley, owing to the strange shape of rocks there.

Hidden Valley has been known to a very few people but has recently been dedicated by the Automobile Club of Southern California, which has put up signs to direct the traveler.

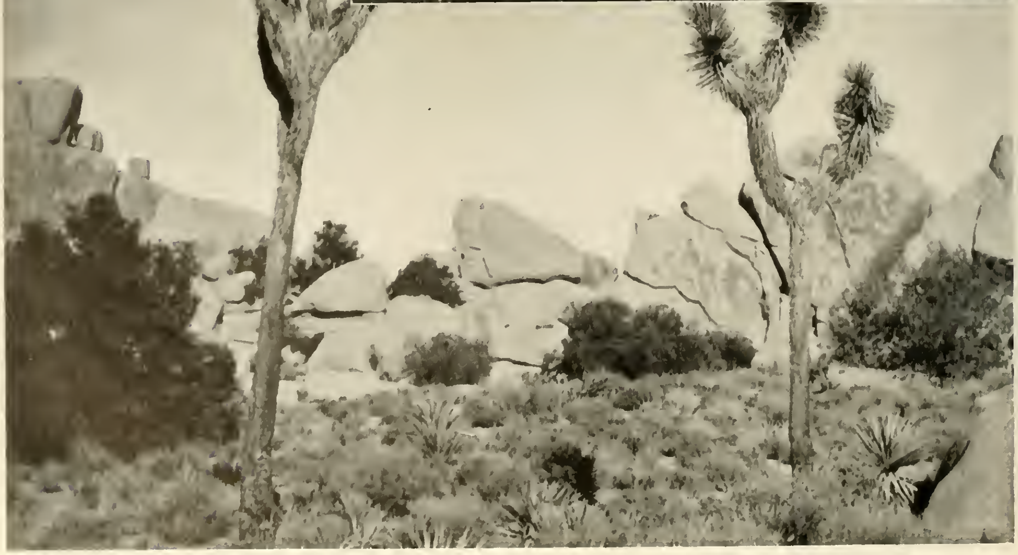


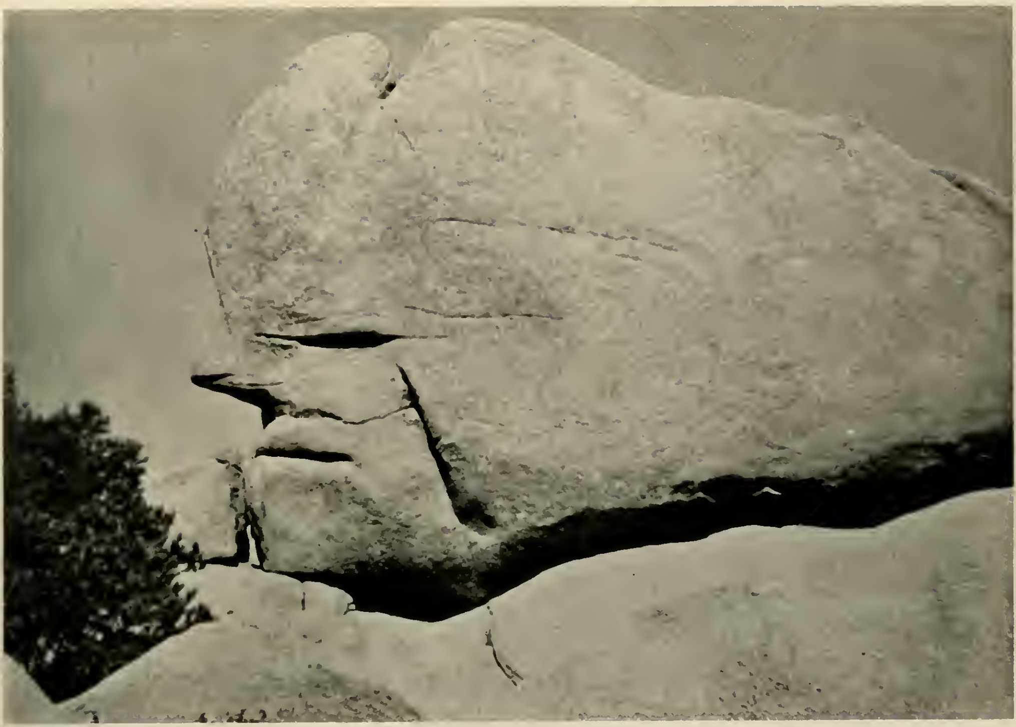
(*Left*) Since the rocks surrounding the valley are almost impossible to climb over, the only way in is through this tunnel in the rocks

(*Right*) A view inside Hidden Valley



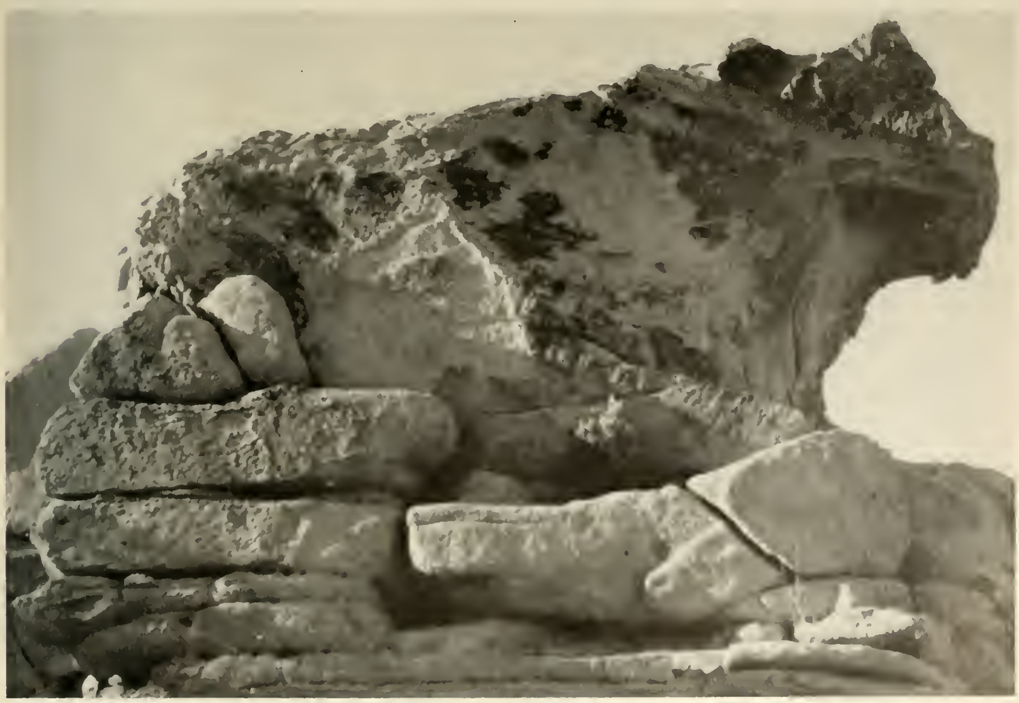
(*Below*) The astonishing formation known as Trojan Rock, from a distance



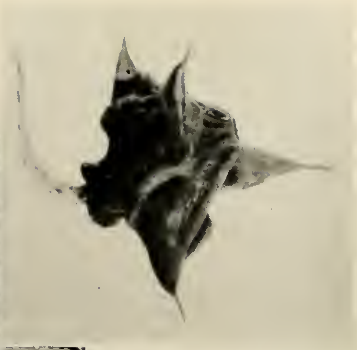


Trojan Rock, carved by natural forces in remarkable likeness of a human head, is 40 or 50 feet high

(Below) Bull Rock, another natural rock formation, is perched upon a rock pile some 300 feet high



Beware of the CALTROP



Why is this object called a caltrop?

(Left) **Do not transplant** the caltrop, or water chestnut

Photos by Fish and Wildlife Service, U. S. Department of the Interior

By BRUCE BROWN

THE object at upper right is the seed of a plant and is called a caltrop because of its resemblance to the spiked object thrown in front of attacking cavalry and elephants by the armies of the ancients. This type of caltrop, however, is not an impediment to elephants but to navigation, particularly in the Potomac River. Native only to Europe and Asia, it was inexplicably introduced to the waters along the mid-Atlantic coast about 20 years ago. In fresh water it spreads rapidly and soon impedes navigation and chokes out other vegetation. The accompanying photographs show the large floating mass, which is held to the bottom by cord-like stems, sometimes fourteen feet long. The mature plant weighs about 20 pounds to the square yard. In water less than eight feet deep motorboats, yachts, rowboats, and canoes find it almost impossible to pass. The seeds have long, sharp, curved spines that make painful sores.

When in 1933 the caltrop formed extensive beds from Washington, D. C., southward for a distance of 40 miles, the problem of eliminating this undesirable plant became a serious concern of the Fish and Wildlife Service. A few years later, when the pest restricted river traffic to a narrow channel, United States Army engineers forgot the old byword "All's well on the Potomac" and joined the Service in its effort to find a way to cope with the problem.

Chemical spraying was attempted without much success, and underwater mowing machines were used with varying results. Hand labor has been successful in controlling the water chestnut, as the plant is otherwise known, but is expensive and tedious. The transplanting of this plant is strongly discouraged, as it wipes out other plants valuable to waterfowl and discourages fish. "Do not spread it," Wildlife officials implore visitors who are attracted by the luxuriant foliage of the plant in June. "We are bending every effort to wipe out the pest."

New York State authorities are taking measures to prevent the caltrop from spreading down the Mohawk and Hudson rivers in the vicinity of their junctions. In the Massachusetts area, the plant is localized and for some reason has not spread.

The caltrop spreads rapidly, impeding navigation and discouraging fish and waterfowl

continued from page 281

covite and Canadian phlogopite) is used in place of the porcelain of your auto's plugs, because the airplane motor is operated at higher temperatures, high compressions, and with greater and more sudden temperature changes, and only mica will stand the strain.

There are innumerable other uses for this essential highly critical mineral, for example, Christmas tree snow, a powder to prevent sticking, and so on; but these are not the uses which place it on the critical list. Rather, it is the electrical and the airplane uses which make it so essential now.

American prospects are not good. In the last war little increased production took place. Then our foreign source was never threatened, but today we probably shall have to develop many more sources, and many old pits will be reopened. Mica mining is a small operation, with perhaps one man working in his spare time, perhaps several; but the nature of the deposits and the irregular yields make it a precarious venture. Best results are obtained when salable quantities of feldspar and beryl are also recovered, and often the sales of scrap mica for crushing will carry the cost of mining the better quality material. Prospects are very poor, and costs will unquestionably be far higher if we are forced to resort entirely to Western Hemisphere deposits. Domestic consumers furthermore will require a little education to overcome what appears from U. S. Bureau of Mines tests to be an unwarranted prejudice against American mica.

Canada, the United States, and South America will unquestionably increase their production this year, and some of the nonessential mica uses may be eliminated. Lower grade micas may be substituted in places where formerly only the best was used, often, probably, without any reduction in quality. Lastly, there is some hope for the development of a mica substitute from inorganic material, but there are still some kinks to be ironed out before that is done. Meanwhile, we must hoard our mica, use it wisely, develop our own deposits, educate our consumers, and expect to pay more for the mica we use. Remember that the cost of the mica has never been a very high percentage of the cost of our electrical products. After all, a $200 motor only has 40 to 50 cents' worth of mica in it.

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DO NOT MISS

Next month NATURAL HISTORY will publish the eighth and last installment in its panoramic series on animal history in North America. Under the title **ICE AGE WINTER RESORT**, Dr. Edwin H. Colbert will tell how the descent of the Great Glacier forced animal life constantly southward until Florida became a sunny refuge for such awesome tourists as the mastodon, the mammoth, and the saber-toothed tiger.

Unlike most owls, it is a bird of the day as well as the night, thus affording naturalists an unusual opportunity to study its family life. The bird is **THE SHORT-EARED OWL**, and G. K. Yeates has visited its haunts to pen what is both a well-observed portrait and a keenly-felt appreciation.

There can be no vaster view in all our panoramic land than the one from atop **MOUNT SAN JACINTO**. The account Tom Hughes gives of this sheerest of the nation's precipices should fire the mountain lover's heart with ecstasy.

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URGENT

The Museum Library is in need of back issues of NATURAL HISTORY, particularly the first four issues for 1942. Copies sent to the Librarian, The American Museum of Natural History, New York, will be greatly appreciated.

DO NOT MISS

In **THE TALKING DRUM FROM MANGBETU LAND,** Dr. James P. Chapin, veteran Congo ornithologist, will recount an engaging series of adventures he had while securing one of the Museum's prized possessions from the Dark Continent. Dr. A. I. Good, who has resided for many years in West Africa, will explain for the first time in any popular magazine the system whereby the natives communicate by means of the drum.

Few people realize that there are over 55 species of wild orchid in the state of Vermont. Here Carl T. Ramsey established his **WILD ORCHID SANCTUARY,** setting an excellent example for all interested in preserving America's floral wealth from the ravaging inroads of the peat moss traffic, the nerve medicine business, and sundry other commercial encroachments.

Picturing Minerals that shine in the dark

By CHARLES H. COLES

Chief Photographer, The American Museum of Natural History

THE glowing face of your wrist watch, the light from the newest type of tubular lamp in your kitchen, the feeble glow of the firefly in your back yard, are various forms of a phenomenon known as luminescence—"cold light" in the sense that it has little heat. The peculiar qualities of these types of light make for interesting photographic possibilities, if you are looking for something out of the ordinary on which to train your camera.

Three general types of luminescence are commonly recognized. *Chemiluminescence* usually depends upon the oxidation and reduction of chemical compounds. *Phosphorescence* is visible light which is given off by a compound after the light which stimulated it has been extinguished. *Fluorescence* is visible light given off by a compound when invisible light of short wave length strikes it. It is this latter type of luminescence which has been found so useful in photographic analysis of documents and experiments with minerals.

The fluorescent effect is most interesting when no appreciable visible light is mixed with the invisible light impinging on the luminescent material. Then the activated substance appears to glow mysteriously as if it were generating its own light. Ultra-violet light, X-rays, and the radiation from radium, though of themselves invisible, are all capable of producing visible emanations in certain substances. This emitted light, known as fluorescence, may be of almost any color, depending upon the composition of the material irradiated.

X-rays and radium radiations are so dangerous that it is wise for the inexperienced to avoid their use for experimental purposes. Ultra-violet radiation can also be harmful, but with reasonable care it is quite safe.

The cheapest source of ultra-violet light, and one that is altogether harmless, is a two-watt argon-filled glow lamp, which can be purchased at a small price from scientific supply houses and dealers in minerals. This bulb is merely screwed into a regular lamp socket on the house current. A dim violet glow can be seen around the electrodes in the bulb. This glow generates a small and thoroughly safe amount of ultra-violet light, which penetrates the glass bulb and is used to irradiate fluorescent substances.

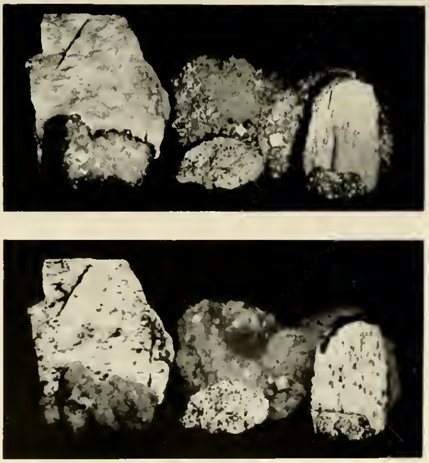
A stronger source of ultra-violet light is the so-called "black bulb," which can be purchased for about $1.25. This is essentially an incandescent bulb, but its glass is of such a deep purple that very little visible light escapes.

Quartz-enclosed mercury vapor lamps used with deep purple filters are a very strong source of ultra-violet and must be used with care. Severe sunburn and painful conjunctivitis may easily be contracted if the mercury arc is used carelessly. However, it is such an excellent source of strong ultra-violet radiation for scientific purposes that it is much used for investigating fluorescence.

An electric discharge from a spark coil passed between iron points in air produces a wide range of frequencies in the ultra-violet; but the added danger of the high voltage, as well as the noise of the sparks and the radio interference caused, keeps this arrangement restricted to scientific laboratories.

When the source of ultra-violet light is in operation, various substances may be tested for fluorescence by bringing them close to it in a darkened room. Certain minerals exhibit a strong fluorescence that is exciting to see. Willemite from New Jersey shines a bright green. Pectolite from the same state glows a faint yellow. Some fluor spar, from which the phenomenon received its name, shines an intense blue.

Continued on page 292



FLUORESCENT MINERALS UNDER ARTIFICIAL LIGHT

AND

UNDER ULTRA-VIOLET LIGHT

Photos by the author

YOUR NEW BOOKS

PHOTOGRAPHIC CHRONICLE OF THE PUEBLOS ● MYTHS ABOUT THE STARS
DR. BEEBE'S LATEST BOOK ● INDIANS OF SOUTH AMERICA

INDIANS OF SOUTH AMERICA

by Paul Radin

Doubleday, Doran, $4.00

THE third book in the American Museum of Natural History Science Series, issued by Doubleday, Doran, is a timely volume on the Indians of South America by Paul Radin. The emphasis is upon the less civilized tribes whose descendants are scattered over approximately nine-tenths of the continent. The author's method is descriptive, beginning with historic accounts of typical tribal groups.

To give the book unity and continuity the author sets up a theoretical scheme of historical interpretation based upon comparisons and contrasts with North American tribal cultures. The reader may find some of these interpretations startling and bold, but the author warns him that they are far from proved. For example, Peru is credited with taking the first step toward civilization by raising cotton and maize, and passing these elements of higher culture on to Central America where they reached their zenith at the hands of the Maya about 1100 A.D. The author's theory is that maize and agriculture came to the wild tribes east of the Andes from the United States via the West Indies, not before 1100 A.D. He is not even sure that many parts of the low countries in South America were inhabited before the Christian era.

The reader may well reserve judgment as to the dates offered by the author, but his theories do serve to give continuity to the text. The layman may find the reading heavy going but he will retain a new impression of what it is that makes Latin America so different. The time may come when "Indian America" will be the preferred term for all the countries south of the United States.

CLARK WISSLER.

THE PUEBLOS: A Camera Chronicle

by Laura Gilpin

Hastings House, $3.00

AS indicated by the subtitle, this is primarily a book of photographs of the pueblos and cliff dwellings of the Southwest, and they were made by one of America's leading outdoor photographers. Every photograph is a picture proclaiming Miss Gilpin the artist that she is. In short the illustrations are superb, and one is reminded of the fact that a good photograph often expresses more than pages of printed text.

But in this book we have both, although the pictures predominate as they should. "Many pictures and very little text" seems to have been the slogan. The locality of each photograph is indicated in a brief discussion beneath it or on the opposite page. These discussions may be looked upon as extended captions, but they are much more. Carefully written, they contain a great deal of pertinent anthropological and human-interest material that enhances one's interest in the photographs. The author has gone to great length to make sure that the statements are accurate and dependable, and in her preface thanks those scientists who have aided her.

The dating of the subjects treated, by means of Doctor Douglass' tree-ring chronology, adds to the interest, and Miss Gilpin explains very simply and clearly the achievement of Doctor Douglass in counting time back through the centuries by means of his "talking pines."

Here we have beautiful and unusual photographs of the cliff dwellings of Mesa Verde; the ruins at Aztec (unfortunate name), New Mexico; Pueblo Bonito in Chaco Canyon; Keet Seel in Navaho National Monument; the famous White House of Canyon de Chelly; Shiprock; Rito de los Frijoles; Acoma, the "Sky City"; San Ildefonso, the home of Julian and Marie Martinez, the famous pottery makers; Santa Clara Pueblo, also famous for its pottery; the five-story apartment houses of Taos; and many others. We have presented here in small space much of the life and folklore of our Southwest by one who is genuinely interested in the Indians as people.

CLYDE FISHER.

BOOK OF BAYS

by William Beebe

Harcourt, Brace, $3.50

TO the graceful yacht *Zaca*, bearing the 38th expedition of Doctor Beebe's Department of Tropical Research, the western coast of Mexico and Central America offered 40 or more bays with opportunities for zoological observation and collecting. Templeton Crocker, patron and gracious host, furnished every facility for work; and the cruise lasted five months in 1937-38, extending from Guadalupe Island off Lower California to the Gulf of Panama and Gorgona Island.

The more serious technical results, we are told, have been appearing in strictly scientific publications; and we have here only "the froth of the trip." As might be expected, it is full of flavor. With unending curiosity, Doctor Beebe serves up a vast array of animals, from minute phosphorescent crustaceans and the tiniest baby sailfish up to sea elephants and whales. Vegetation along the coast, ranging from desert scrub to heavy rain forest, garnishes the feast.

At times we are taken ashore to towns such as Manzanillo and Acapulco, or farther inland to the capitals of Salvador and Costa Rica. Wild creatures and scenery along the way are contrasted with human behavior, and the author's enthusiasm reaches into dance hall, circus, and natural history museums. He is equally delighted with a tide pool by flashlight, a fiesta in Manzanillo, the dancing courtship of fiddler crabs, and the wedlock of angler fishes.

This could be a guide for tourists tempted to follow the same route, but will more often serve as an armchair cruise into realms still mysterious even to a trained zoologist. Keep an encyclopedia handy, to avoid stumbling over the brotulids and oikopleura. Otherwise you must jump to the next paragraph and new thrills. Limpets you should know, and they can furnish a firm foothold. As a former "Zacasian" I take a special joy in Will Beebe's latest book.

JAMES P. CHAPIN.

THE STARS IN MYTH AND FACT

by Oral E. Scott

Caxton, $3.00

THE Stars in Myth and Fact is a book written by a man for whom astronomy is an intensely interesting hobby, a hobby followed for 20 years. Mr. Scott presents the cream of the myths based on the constellation figures and combines in each chapter mythological conceptions of the ancients with modern-day astronomical figures.

One of the most interesting aspects of the book is the discriminating choice of poetic excerpts regarding the stars and the constellations. Another is the popularly-presented derivation of many of the common star names. For those who find Allen's *Star Names*—which is, of course, authoritative on this subject—too erudite, Mr. Scott's book presents a less difficult and more readable volume of material.

Line-drawings and star charts abound, but in most cases these would be rather difficult for the beginner to follow, as must honestly be said of almost all charts.

Now and then in perusing the pages of this book the astronomer will stop short. There is much here that seems not to belong in an astronomical volume, even in one dealing with myths. For instance, at the end of Chapter Eleven, "Symbolism of the Bears," Mr. Scott says:

"In the Indian legend the lost hunters

LETTERS

Continued from page 244

Sirs:

Your magazine has brought so many articles of intrinsic interest, written in impressive manner, concerning diverse aspects of geology and paleontology, that I want to congratulate you on the accomplishment which this feat alone represents. I have read your magazine for years and have referred to articles in it frequently in connection with my former teaching of historical geology in the University of Cincinnati.

Recently, I met a number of my former students who are stationed in camp. They find the transition from the academic environment in which they were following their intellectual interests, to the steadily tightening discipline of the camp difficult indeed. This is natural enough. As long as they are stationed in our regular camps, however, a certain amount of time is available for recreation and reading for those who care for it. I wonder to what extent your magazine is finding its way into the reading rooms of the military camps. It appears to me to be ideally suited for the casual reading of young men interested in natural history in all its aspects.

I am interested in this matter not only as Chairman of the Section of Geology of the New York Academy of Sciences, but also as Chairman of the Division of Geology and Geography of the National Research Council. I hope sincerely that you will find it possible to secure the funds to distribute Natural History to all the military camps in this country. It would seem possible that government funds could be made available for that purpose or perhaps some of your members might be induced to subscribe to the Magazine on behalf of specific camps.

If there is any way in which I can be of assistance in this matter I shall be glad to do so.

Walter H. Bucher.

National Research Council,
Washington, D. C.

* * *

In order that men in the armed services may maintain an interest in the broad horizons of discovery and conservation and an appreciation of the works of Nature, Natural History Magazine urges readers to heed this suggestion. A three-dollar check, which does not even pay the cost of producing the Magazine, will enable the American Museum to send Natural History to any man in the service for one year. Designate to whom you would like to have the Magazine addressed, or let us select a camp library where Natural History will be welcomed on its shelves.—Ed.

* * *

Sirs:

. . . Mr. Grant certainly deserves much praise for his ruffed grouse photograph [Cover for March]. As a hunter I know how difficult it must have been to secure such a shot . . .

G. Duncan Briggs.

Rehoboth, Mass.

BOOKS

Continued from page 291

prayed for guidance, and were conducted safely home by the little child, who proclaimed herself the spirit of the Pole Star. Hebrew literature suggests a similar idea —'A little child shall lead them.' Jesus likewise taught: Whosoever shall not receive the Kingdom of God as a little child, shall not enter therein. . . . Only intuition grasps essential spiritual truth, which is the essence of the Kingdom within. . . ."

There are undoubtedly enough people who would like this kind of writing to make up a good-sized audience for Mr. Scott's book. But there are many who will feel that the good characteristics of *The Stars in Myth and Fact* are overshadowed by the occasional religious and astrological interpolations.

The teacher of astronomy and the amateur will find herein many new and useful suggestions concerning constellation outlines and stories.

Marian Lockwood.

PICTURING MINERALS

Continued from page 290

Wernerite from Canada radiates a golden yellow. Certain calcites glow pink. Autunite fluoresces a vivid green. All of these minerals may be purchased from dealers in rock specimens.

Materials other than minerals will glow if the ultra-violet radiation is strong enough. One's teeth and fingernails glow bluish. Petroleum jelly glows white. Canary glass (glass colored with oxide of uranium) glows a vivid yellow-green. Various inks glow in different ways, pointing to a valuable method in detecting forgeries. Modern laundries mark their customer's property with fluorescent inks that are invisible until they are taken into a darkened room and flooded with ultra-violet light, whereupon the initials glow brightly.

Photographic film is very sensitive to ultra-violet radiation, and although the glass of the lens does absorb the higher ultra-violet frequencies, it still permits a large part of the lower frequencies to enter the camera. You must remember that when you are photographing the phenomenon of fluorescence you do not want your camera to record the ultra-violet but only the visible colors into which it has been transformed, otherwise the film may be fogged. The haze filter that is used for Kodachrome is really an ultra-violet absorbing filter, so this may be used over the camera lens to hold back the unwanted radiation. A still more efficient absorber of ultra-violet is the 2A filter, also used with Kodachrome on cloudy days.

Exposures will necessarily be quite long because of the dimness of the fluorescence. A tripod is a necessity. The exposures must be made in complete darkness, so that only the fluorescence will be recorded.

Kodachrome pictures may be made of fluorescent minerals with striking results. Here, again, the 2A filter must be placed over the lens to avoid an over-all bluish cast in the picture, caused by the invisible radiation. If allowed to enter the lens of the camera unimpeded, ultra-violet light would cause the glass of the lens to fluoresce blue and produce a bluish cast in the color transparency.

Using a mercury vapor lamp enclosed in a deep-violet-colored tube, we found that an exposure of two minutes at f:2 was successful on Kodachrome-A with a 2A filter. The exposure was arrived at by trial and error, the fluorescence being too faint to measure with an exposure meter.

If a weaker source of ultra-violet is used, such as the argon bulb mentioned earlier, much longer exposure would be necessary. It will probably be less expensive to test with black-and-white film before going full out with Kodachrome. Also you will want to take a photograph of the same subject under ordinary light for comparison with fluorescent effect, as we have done with the minerals illustrated here.

We have mentioned only a few of the applications of ultra-violet radiation, for it has a wide range of uses, not only in mineralogy* but in the detection of crime and espionage. So if you yearn for novel experiments in picture-taking try fluorescent photography. It is an unusual field, with strange and interesting possibilities, especially in color.

---

*It may be recalled that deposits of tungsten can effectively be located in the dark by means of ultra-violet radiation. (*See* "Tungsten," by Frederick H. Pough, Natural History, February, 1942, p. 122.)

Sirs:

. . . I will appreciate it if you will let me know if it is possible for you to get me a reprint of the ruffed grouse cover on the March issue. . . . It is a most remarkable and beautiful photograph. By the way, is this a natural color photograph?

Sidney B. Carpender.

New Brunswick, N. J.

Mr. Cleveland Grant's ruffed grouse is a natural color photograph taken with 35 mm. Kodachrome. Copies of it can be obtained from the Editorial Office of Natural History at 5¢ each plus 5¢ additional on each order for wrapping and mailing. —Ed.

NOTICE

Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

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